Engine Mechanical - New Beetle, 2.0L 4-Cyl. - AEG, AVH, AZG, BDC, BEV, BGD

GENERAL, TECHNICAL DATA

TECHNICAL DATA

Engine number

The engine number ("Code letters" and "Serial number") can be found on the joint between engine/transmission.

The engine number consists of up to nine characters (alphanumeric). The first part (maximal 3 characters) makes up the "engine code", and the second part (6 characters), the "serial number". If more than 999,999 engines with the same engine code are produced, the first of the six characters is replaced with a letter.

Additionally there is a sticker on the toothed belt guard with "Engine code" and "Serial number".

The engine code is also included on the vehicle data plate.

Engine code AEG

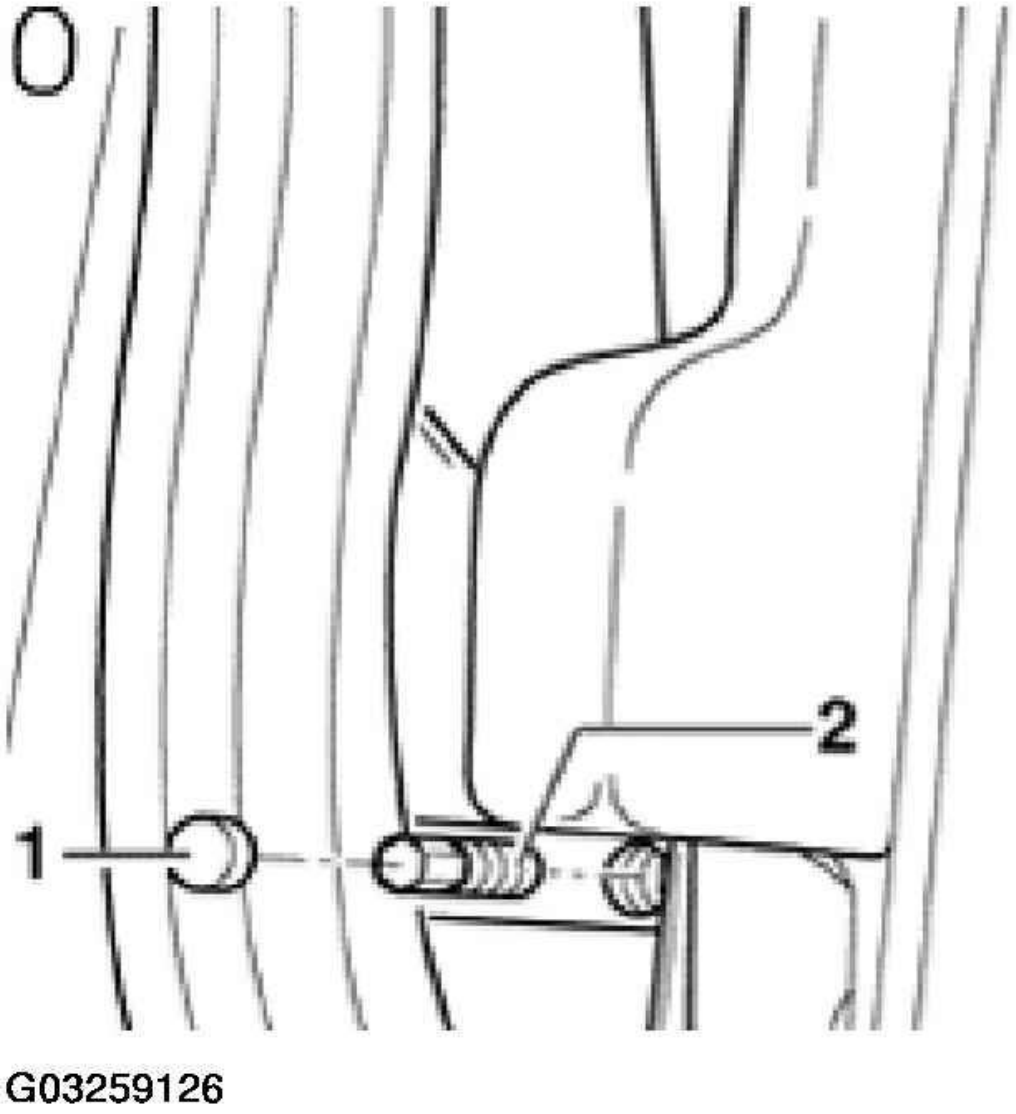


Fig. 1: Locating Engine Code AEG
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine codes AVH, AZG, BDC, BEV, BGD

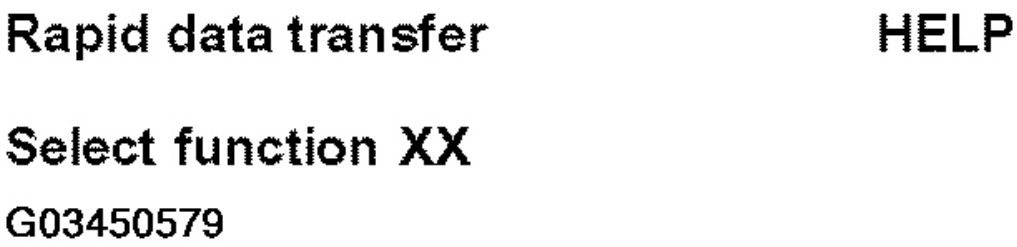


Fig. 2: Locating Engine Codes AVH, AZG, BDC, BEV, BGD
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine data

ENGINE DATA (1 OF 4)

Code	AEG	AVH	AZG	BDC
Manufactured	02.98 & Up	08.00 & Up	10.00 & Up	08.02 & Up
Exhaust emissions fulfil	LEV(1)	ULEV(2)	LEV(1)	ULEV(2)
Capacity ltr.	2.0	2.0	2.0	2.0
Output kW at rpm	85/5400	85/5200	85/5200	85/5400
Torque N.m at rpm	165/2800	165/2600	165/2600	170/3000
Bore diameter mm	82.5	82.5	82.5	82.5
Stroke mm	92.8	92.8	92.8	92.8
Compression ratio	10.0	10.0	10.0	10.0
RON min.	91 unleaded	91 unleaded	91 unleaded	91 unleaded
Injection, ignition	Motronic 5.9.2	Motronic ME7.5	Motronic ME7.5	Motronic ME7.5
Knock control	2 knock sensors	2 knock sensors	2 knock sensors	2 knock sensors
Oxygen sensor control	2 sensors	2 sensors	2 sensors	2 sensors
Self-diagnosis	OBDII	OBDII	OBDII	OBDII

(1) 1) LEV = Low Emission Vehicle

(2) 2) ULEV = Ultra Low Emission Vehicle

ENGINE DATA (2 OF 4)

Code	AEG	AVH	AZG	BDC
Catalyst	yes	yes	yes	yes
Exhaust gas recirculation	no	no	no	no
Charging	no	no	no	no
Secondary air system	yes	yes	yes	yes
Variable intake manifold	no	no	no	yes
Variable valve timing	no	no	no	no
Electronic Power Control (EPC)	no	yes	yes	yes

ENGINE DATA (3 OF 4)

Code	BEV	BGD
Manufactured	06.03 & Up	06.03 & Up
Exhaust emissions fulfil	LEV2(1)	ULEV2(2)
Capacity - ltr.	2.0	2.0
Output - kW at rpm	85/5200	85/5400
Torque - N.m at rpm	165/2600	170/3000
Bore diameter - mm	82.5	82.5
Stroke - mm	92.8	92.8
Compression ratio	10.0	10.0
RON - min.	91 unleaded	91 unleaded
Injection, ignition	Motronic ME7.5	Motronic ME7.5
Knock control	2 knock sensors	2 knock sensors
Oxygen sensor control	2 sensors	2 sensors
Self-diagnosis	OBDII	OBD II

(1) LEV = Low Emission Vehicle

(2) ULEV = Ultra Low Emission Vehicle

ENGINE DATA (4 OF 4)

Code	BEV	BGD
Catalyst	yes	yes
Exhaust gas recirculation	no	no
Charging	no	no
Secondary air system	yes	yes
Variable intake manifold	no	yes
Variable valve timing	no	no
Electronic Power Control (EPC)	yes	yes

ENGINE - ASSEMBLY

ENGINE, REMOVING AND INSTALLING

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 2024 A Lifting tackle
- T10012 Engine bracket
- VW 313 Support clamp
- VW 540 Engine and transmission support
- V.A.G 1202 A Workshop crane
- V.A.G 1306 Drip tray

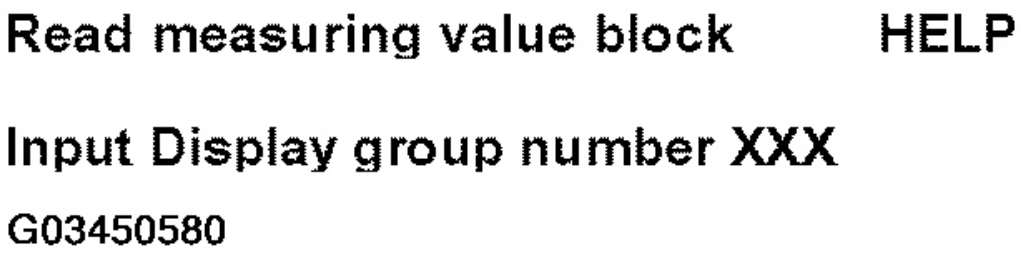


Fig. 3: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)
- V.A.G 1383 A

  Engine/transmission jack

- VAS 5024

  Assembly tool for spring-type clips

- VW 540/1 B

  Supplementary set

- VAS 5085 Step ladder
- G 000 100 Grease (vehicles with manual transmission)
- Bolt M1 0x 25/ 8.8

- Cable tie

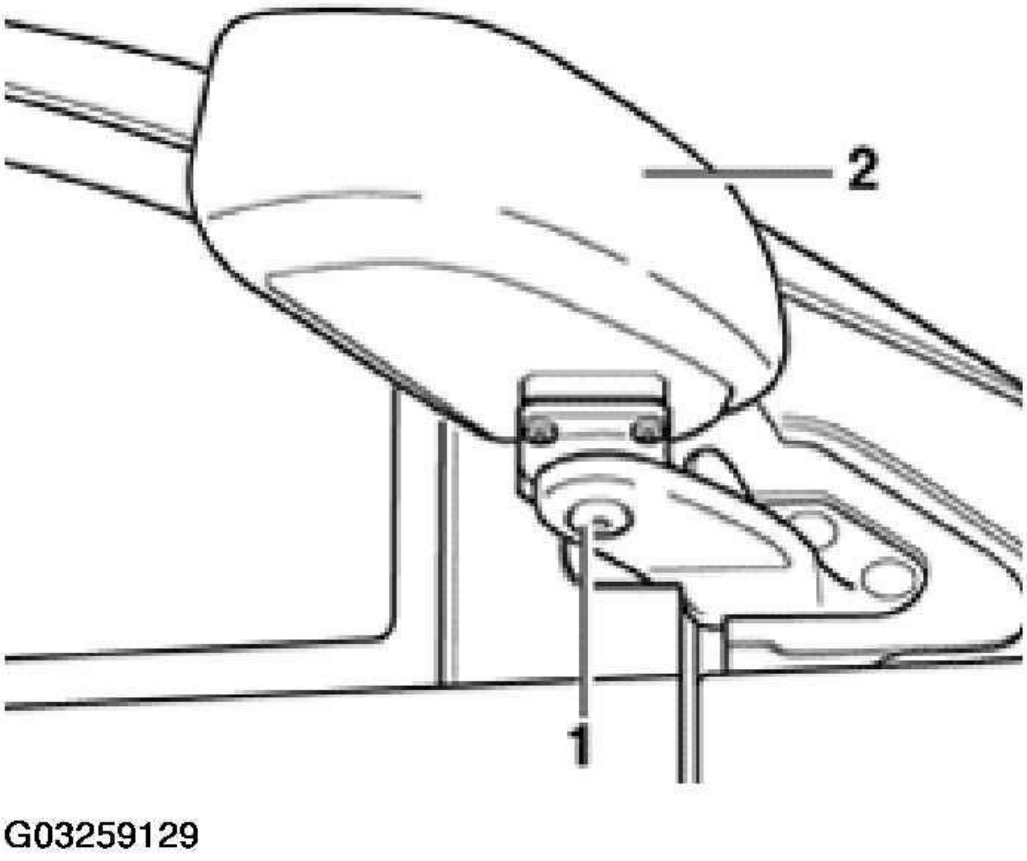


Fig. 4: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine removal notes

CAUTION: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following:

- **Route all types of lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

NOTE: During the further course of work the battery Ground strap must be

disconnected. Therefore, please check whether a coded radio is installed. Obtain the radio code first, if necessary.

- Interrogate fault memories of all control modules before removing engine.

NOTE: **Some components in this vehicle cannot be removed or are very difficult to remove when the engine is installed in the engine compartment. For this reason determine which components are faulty before starting to remove components and replace the faulty components once they have been removed.**

- The engine is removed downward together with the transmission.
- All cable ties which are opened or cut open when removing engine, must be replaced in the same position when installing the engine.
  - With ignition switched off disconnect battery Ground strap.
  - Remove engine cover.
  - Remove power steering fluid reservoir from battery support but do not disconnect/open hoses.
  - Tie reservoir to lock support.
  - Remove battery and battery retainer.
  - Observe rules for cleanliness. See **RULES FOR CLEANLINESS** .

WARNING:

- **Fire Hazard! Do NOT have anything in the area that can ignite fuel!**
- **Fuel system is under pressure! Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.**

Engine codes AEG, AVH, AZG

- Pull fuel supply line -1- as well as fuel return line -2- off fuel rail and collect fuel that leaks out with a clean cloth.
- Pull hose off Evaporative Emissions (EVAP) canister purge regulator valve -N80-.

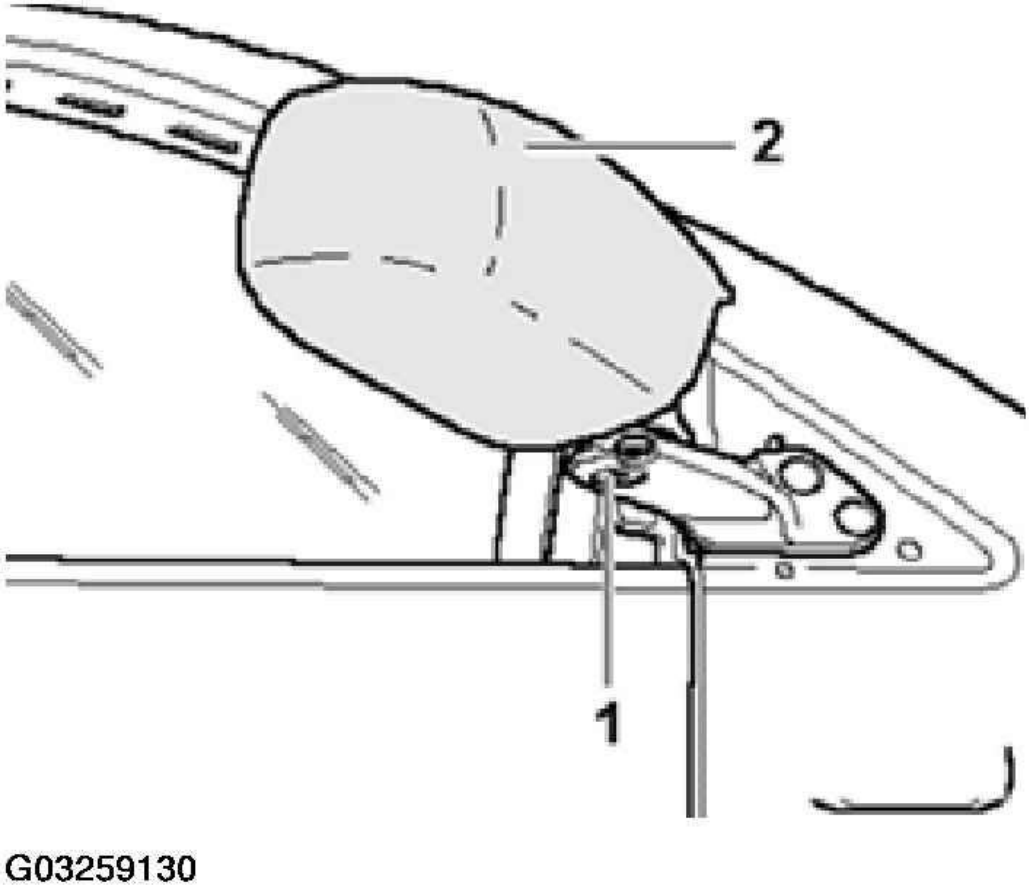


Fig. 5: Evaporative Emissions (EVAP) Canister Purge Regulator Valve Hoses - Engine Codes AEG, AVH, AZG
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine code BDC

- Pull fuel supply line -1- as well as fuel return line -2- off fuel rail and collect fuel that leaks out with a clean cloth.
- Pull hose off Evaporative Emissions (EVAP) canister purge regulator valve -N80-.

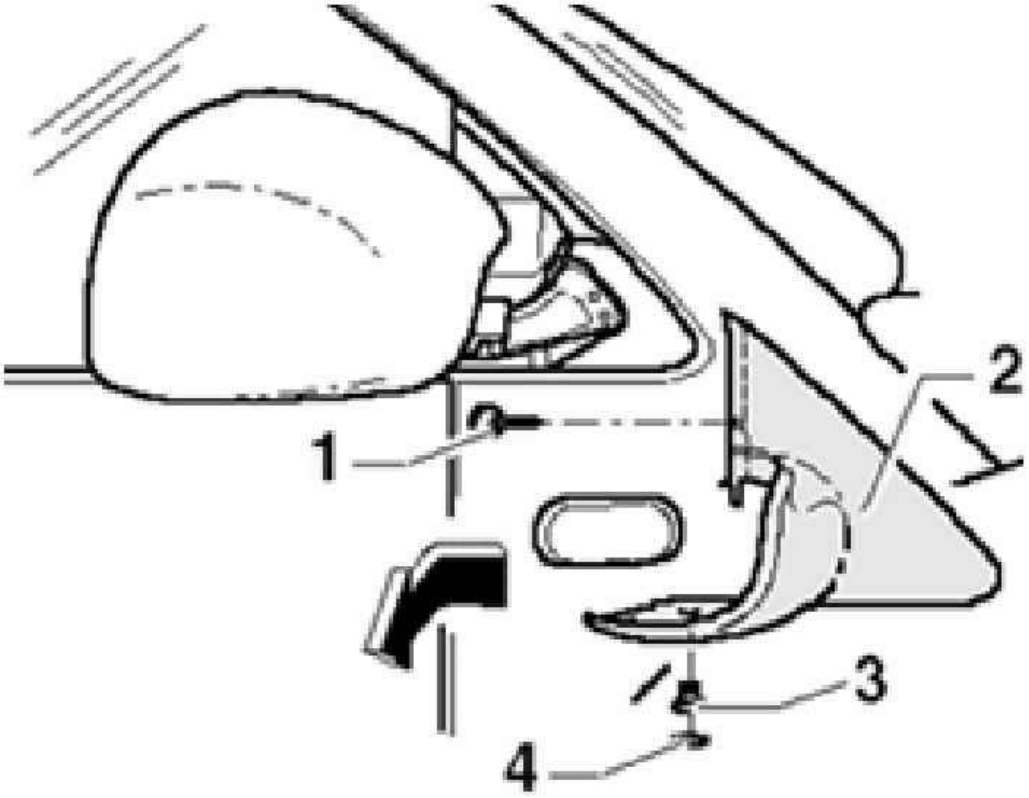


Fig. 6: Locating Fuel Supply/Return Lines & EVAP Canister Purge Regulator Valve - Engine Code BDC
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine codes BEV, BGD

- Pull fuel supply line -1- off union by pressing locking ring -2- into union -3- and collect fuel that leaks out with a clean cloth.

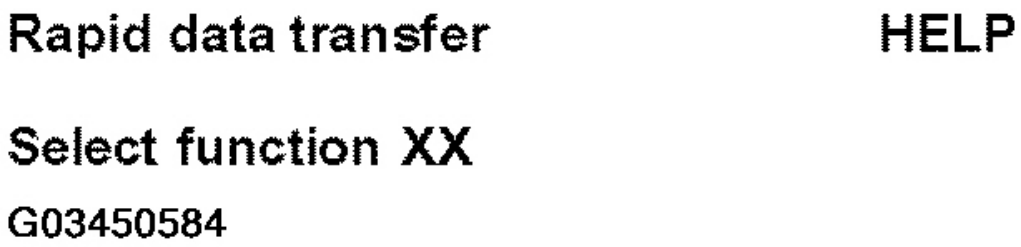


Fig. 7: Locating Fuel Supply Line Locking Ring - Engine Codes BEV, BGD
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Continuation for all models

- Seal lines to avoid contamination of fuel system.
- Pull vacuum and breather hoses off engine.
- Remove air cleaner with intake hose and Mass Air Flow (MAF) -G70-.
- Remove intake manifold upper part. See **INTAKE MANIFOLD UPPER PART, REMOVING AND INSTALLING** .

NOTE: Seal the intake ports in the intake manifold lower section with clean cloths.

Vehicles with manual transmission

- Disconnect shift mechanism from transmission.

  See **SELECTOR MECHANISM**

- Remove hydraulic clutch slave cylinder:

  See **CLUTCH SLAVE CYLINDER** .

NOTE: The clutch pedal must not be operated.

Vehicles with automatic transmission

- Remove selector lever cable from transmission:

  For transmission 01M, see **SELECTOR LEVER CABLE**

- Remove selector lever cable from transmission.

For transmission 09G, see **SELECTOR MECHANISM**

Continuation for all models

- Remove insulation tray.

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Drain coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove supplementary coolant fan on right side of vehicle, if part of original equipment.
- Remove power steering pressure line securing clamps on engine and transmission.
- Remove power steering pump from bracket and tie up to front panel; hoses remain connected.

  See **POWER STEERING PUMP, RESERVOIR, HYDRAULIC LINES** .

Vehicles with air conditioning

- Remove air conditioning compressor:

  See **CONDENSER, REMOVING AND INSTALLING** .

- Observe additional information and removal work. See **ADDITIONAL INFORMATION AND ASSEMBLY WORK ON MODELS WITH AN AIR CONDITIONING SYSTEM** .

Continuation for all models

- Disconnect inter-connecting, coolant, vacuum and intake lines on engine.
- Separate connections on following components:

  Ignition coils -N- and -N128- with

  Final output stage -N122- or Ignition coils with

  Final output stage -N70-, -N127-, -N291-; -N292-

  Camshaft Position (CMP) sensor -G40-

  Injectors -N30-...-N33-, release cable guide

  Engine Coolant Temperature (ECT) sensor -G62-

  Engine speed (RPM) sensor -G28-

  Knock Sensor (KS) 1 -G61-

Knock Sensor (KS) 2 -G66-

Secondary Air Injection (AIR) pump motor -V101-

Oil pressure switch -F1-

if installed, A/C cut-out thermal switch -F163-

Mass Air Flow (MAF) sensor -G70-

Throttle valve control module -J338-

- Unbolt secondary air injection pump and bracket and remove.
- Disconnect all electric wires from transmission, Generator and starter and move clear.
- Disconnect all other electrical connections as necessary from engine and lay to one side.
- Unbolt pendulum support (arrows).

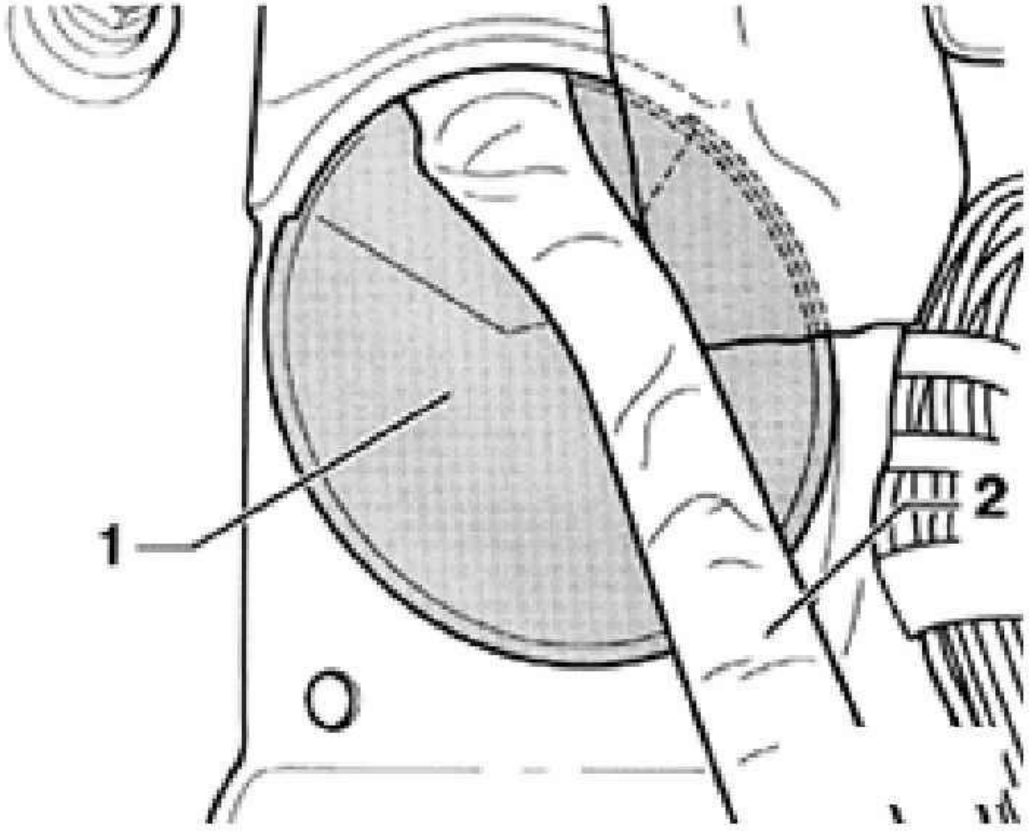


Fig. 8: Removing Pendulum Support Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove protective cover for right side inner constant velocity joint from engine.
- Remove right side axle shaft and disconnect left-hand drive shaft at transmission:

  See **FRONT AXLE SHAFT** .

- Remove front exhaust pipe. See **EXHAUST MANIFOLD, FRONT EXHAUST PIPE AND CATALYTIC CONVERTER WITH ATTACHMENTS** .
- Disconnect connection for oxygen sensor before catalytic converter (under vehicle floor).
- Remove oil sump protection. See **Fig. 138** .
- Insert engine bracket T 10012 in engine/transmission jack V.A.G 1383 A.
- Remove bracket on cylinder block for lower coolant hose. Threaded hole is required to secure engine bracket T10012.

- Secure engine bracket T10012 to front of cylinder block with securing bolt M10 x 25/ 8.8 to 40 N.m.

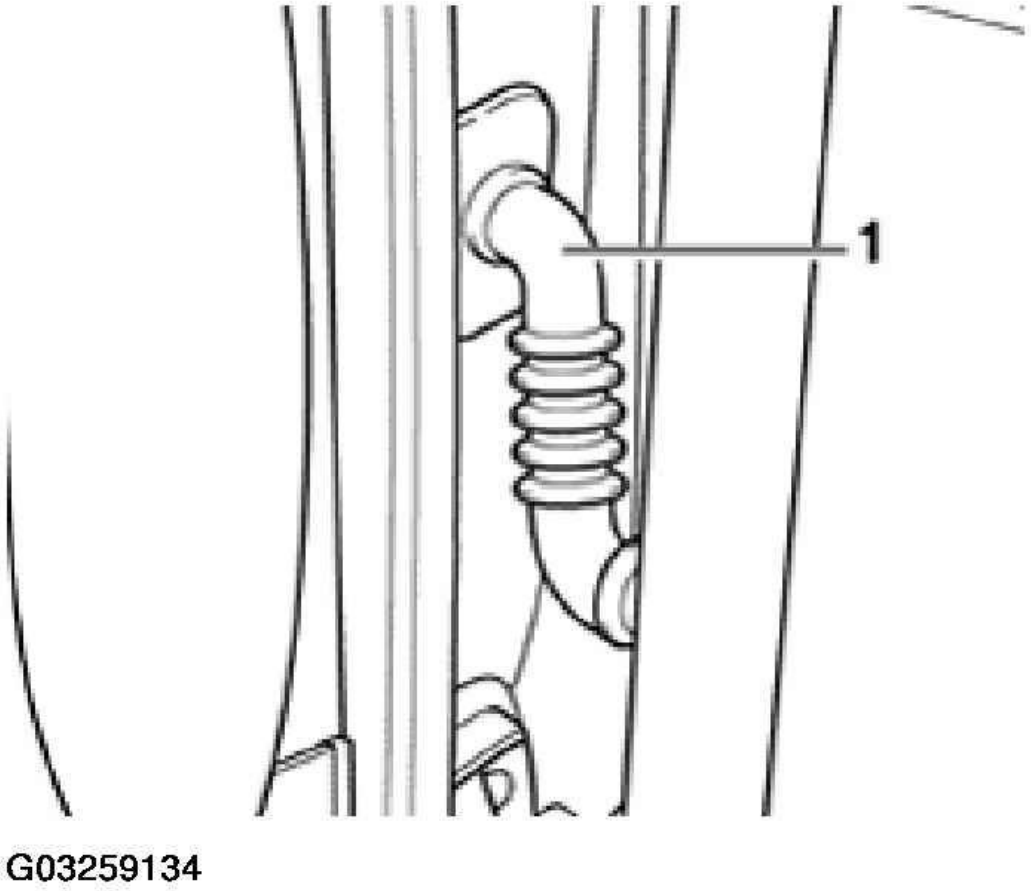


Fig. 9: Securing Engine Bracket To Front Of Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten securing nut on exhaust side hand tight.
- Lift engine and transmission lightly using engine/transmission jack V.A.G 1383 A.
- Unbolt engine side of assembly mounting from engine carrier at top (arrows).

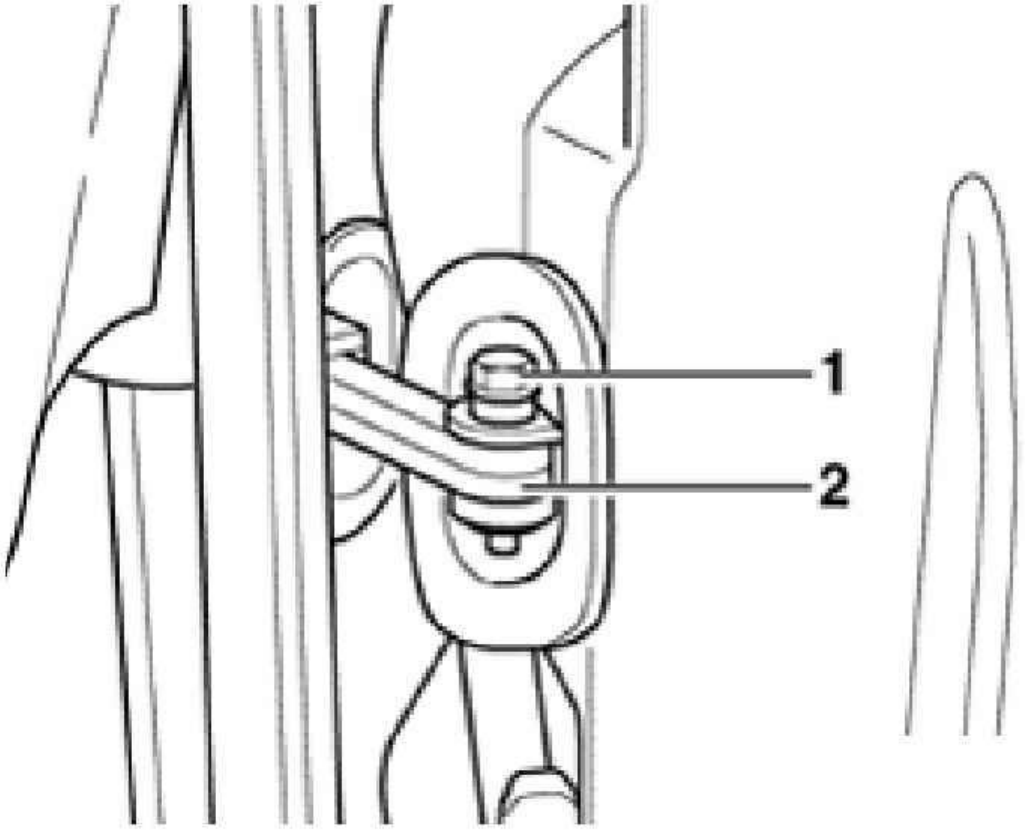


Fig. 10: Removing Engine Side Of Assembly Mounting Bolts From Engine Carrier At Top
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Use ladder VAS 5085 to remove securing bolts.

- Unbolt transmission side of assembly mounting from top of transmission carrier (arrows).

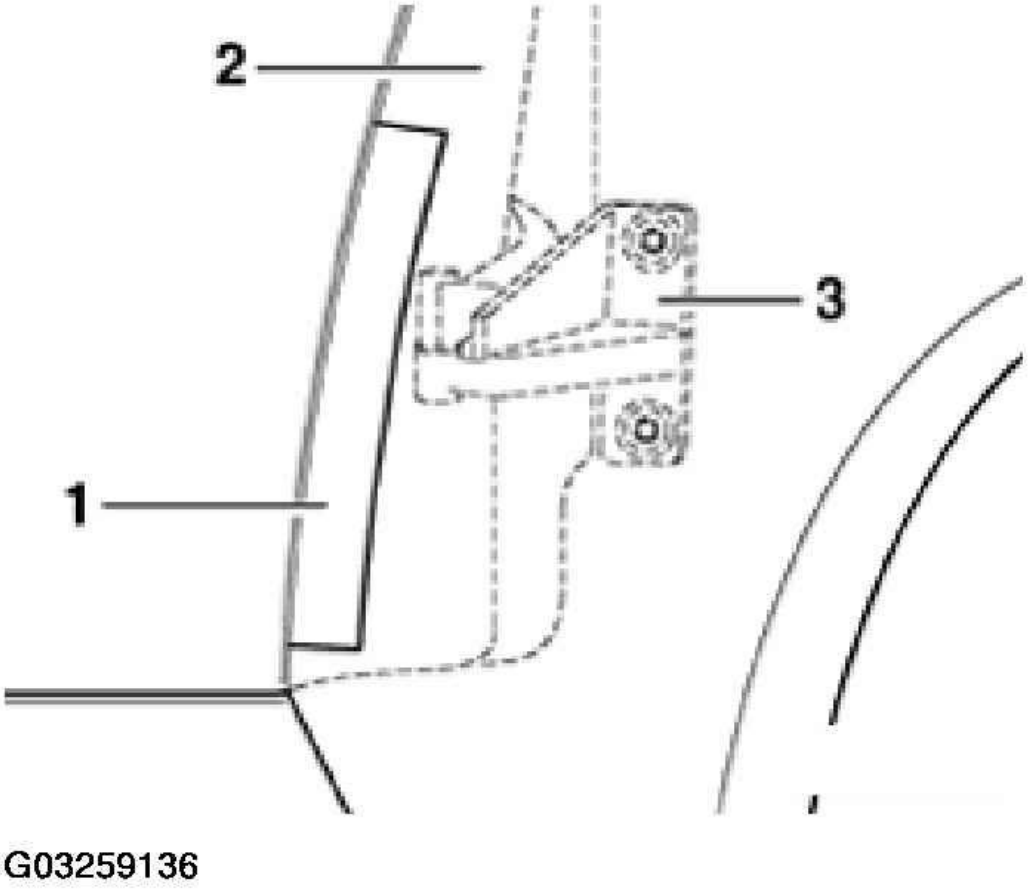


Fig. 11: Removing Transmission Side Of Assembly Mounting Bolts From Top Of Transmission Carrier
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lower engine with transmission.
- While lowering engine guide power steering pressure line past transmission.

NOTE: Engine and transmission must be guided carefully when lowering to prevent damage to the bodywork, hoses and wiring.

Engine, mounting on assembly stand

When working on the engine, it should be secured to the assembly stand support clamp VW 313 using the engine and transmission bracket VW 540 and supplementary set VW 540/1B.

Work sequence

- Move engine/transmission assembly to a work bench with jack V.A.G 1383 A.

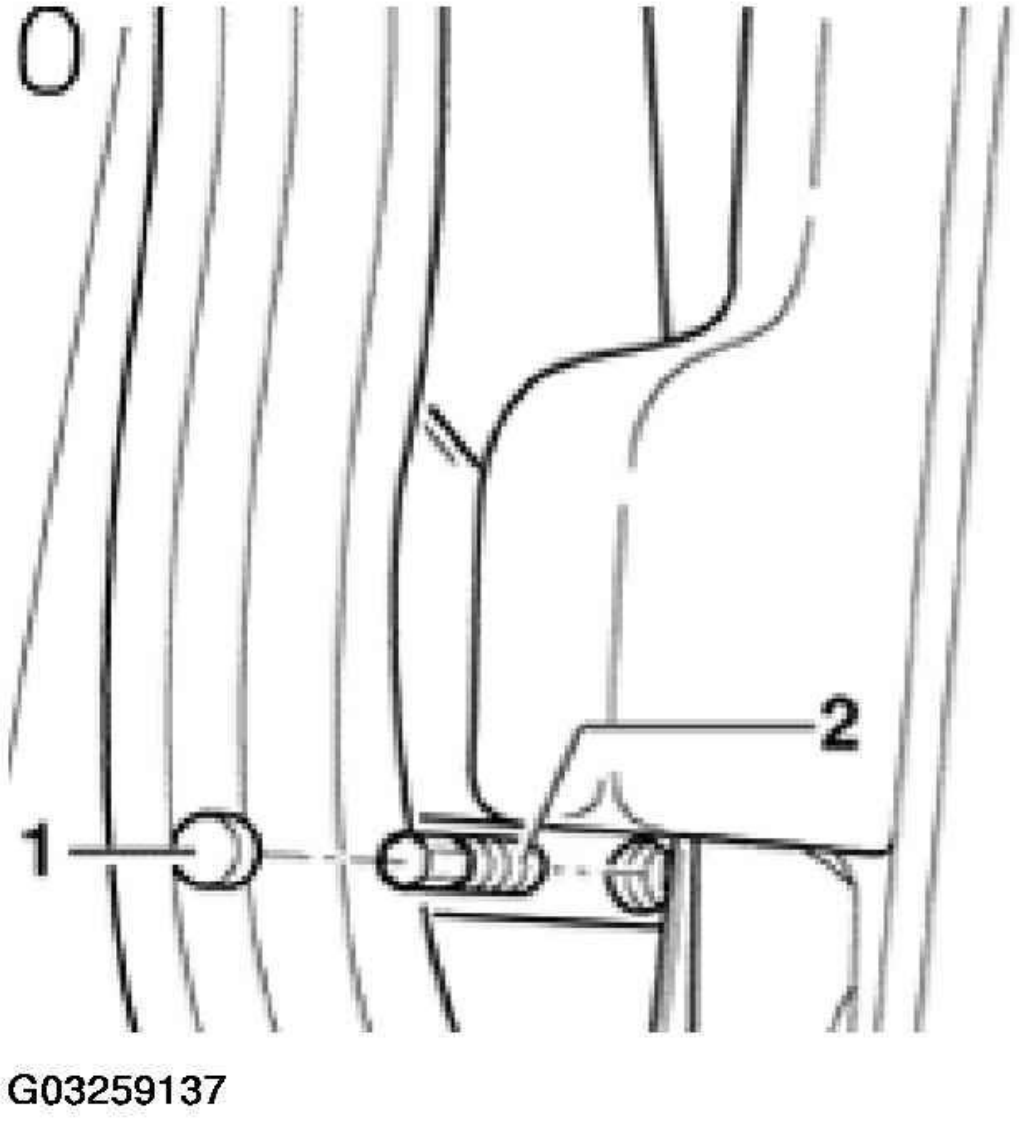


Fig. 12: Moving Engine/Transmission Assembly To Work Bench With Jack
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lower engine/transmission assembly so that transmission is on work bench.
- Remove engine/transmission connecting bolts.
- Press off transmission.

Continuation for all models

- Attach lifting tackle 2024 A as follows and lift off engine/transmission jack V.A.G 1383 A with workshop crane.

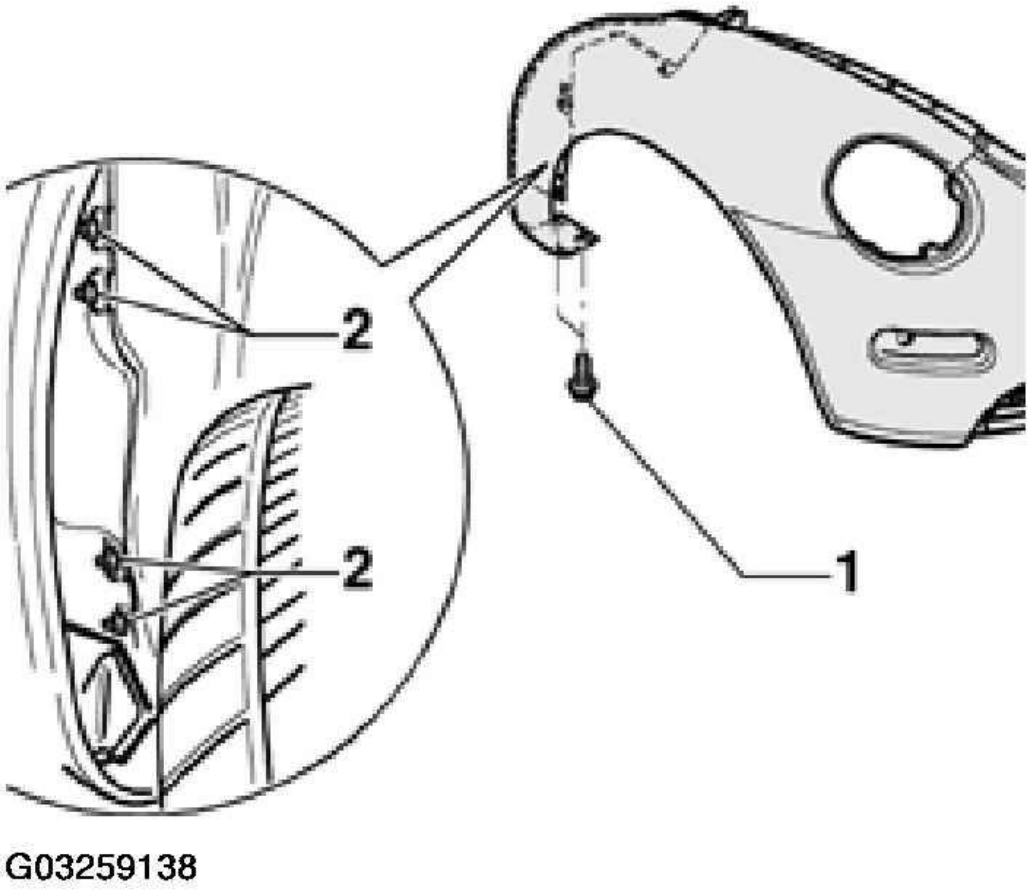


Fig. 13: Attaching Lifting Tackle To Engine Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pulley end: 3rd hole of lifting rail in position 2

Flywheel end: 3rd hole of lifting rail in position 8

CAUTION: Hooks and locating pins must be secured with locking pins.

NOTE: Positions marked 1...4 on the bar must face toward belt pulley end. The holes in the hook rails are counted up from the hook.

- Secure engine to support clamp VW 313 using engine and transmission bracket VW 540 and supplementary set VW 540/1B. Dowel sleeves must be removed.

Engine installation notes

Installation is performed in the reverse sequence, Note the following.

WARNING: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following:

- **Route all types of lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

- Insert new dowel sleeves in cylinder block for centralizing engine and transmission.
- Fit intermediate plate onto sealing flange and slide onto dowel sleeves (arrows).

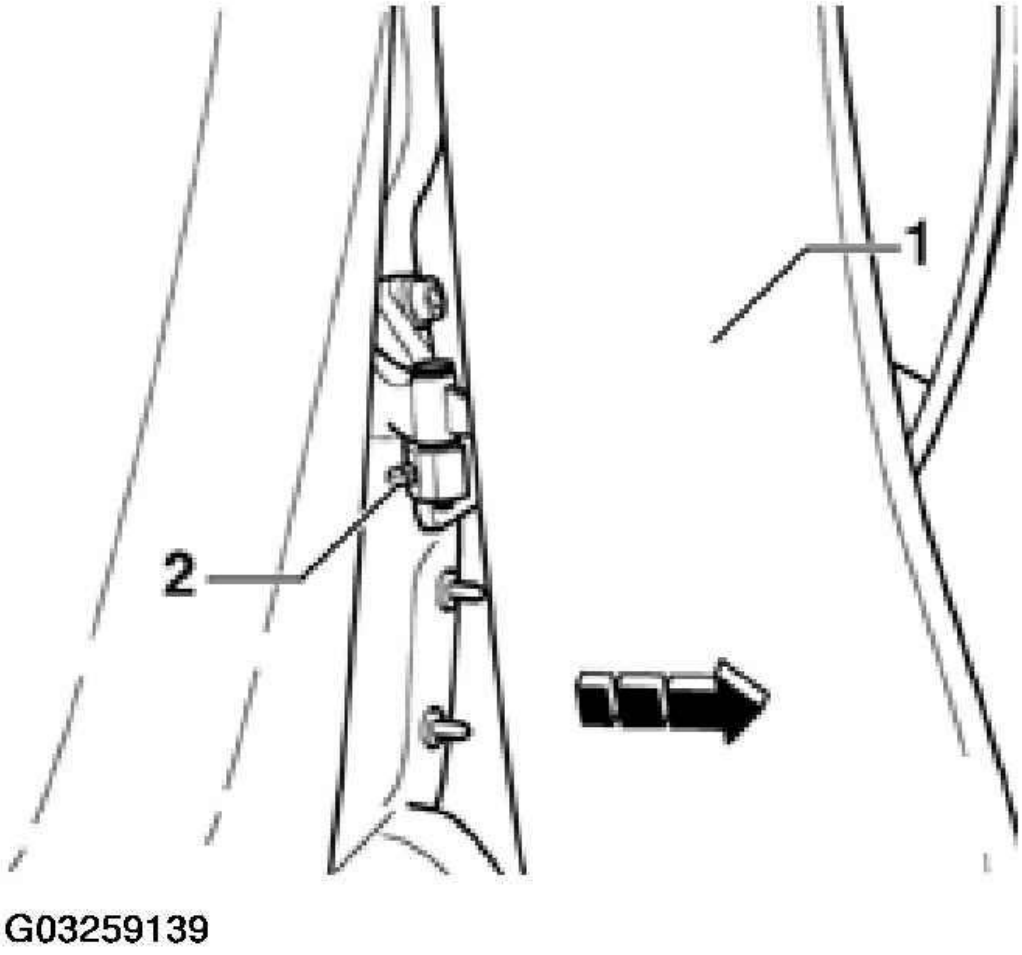


Fig. 14: Fitting Intermediate Plate Onto Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Vehicles with manual transmission

- Lightly grease input shaft splines with G 000 100 grease.
- Check clutch and clutch operating mechanism, then install.

  See **CLUTCH ASSEMBLY** .

- Install gear shift mechanism, adjust gear shift cables if necessary:

  See **SELECTOR MECHANISM**

Vehicles with automatic transmission

- Install selector cable on transmission, adjust if necessary:

  For 01M transmission, see **SELECTOR LEVER CABLE** .

- Install selector cable on transmission, adjust if necessary:

  For 09G transmission, see **SELECTOR LEVER CABLE** .

NOTE: Always replace selector cable circlip

Vehicles with air conditioning

- Install air conditioning compressor:

  See **CONDENSER, REMOVING AND INSTALLING** .

Continuation for all models

- When installing engine/transmission assembly, ensure sufficient clearance to engine and transmission mountings and radiator.
- When doing this guide power steering pressure line past transmission.
- Align assembly mountings for engine and transmission. See **ENGINE AND TRANSMISSION MOUNTINGS, ALIGNING** .

NOTE: Torque settings. See ASSEMBLY MOUNTING .

- Install right side axle shaft and attach left side axle shaft to transmission.

  See **FRONT AXLE SHAFT** .

- Install front exhaust pipe. See **EXHAUST MANIFOLD, FRONT EXHAUST PIPE AND CATALYTIC CONVERTER WITH ATTACHMENTS** , Removing and installing parts of exhaust system.
- Install power steering pump:

  See **POWER STEERING PUMP, RESERVOIR, HYDRAULIC LINES**

- Reconnect electrical connections and check routing.
- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Install secondary air injection pump.
- Install center, left and right insulation trays:

See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Fill system with coolant. See **COOLING SYSTEM, DRAINING AND FILLING**

Vehicles without EPC

- Adjust accelerator cable. See **ACCELERATOR CABLE, ADJUSTING** , servicing accelerator mechanism.

Vehicles with EPC

- Adapt (match) engine control module to throttle valve control. See**COMPONENTS AND FUNCTIONS, ADAPTING** , Adapt components and functions

Continuation for all models

- If fault memory has been erased or engine control module was disconnected from permanent positive, respective components must be adapted to engine control module. See **ENGINE CONTROL MODULE FAULT MEMORY, INTERROGATING AND ERASING** , and readiness code generated again.
- Road test vehicle and interrogate all fault memories:

  Observe the valid safety precautions when performing a road test. See **SAFETY PRECAUTIONS** .

- Read readiness code.

Vehicles with automatic transmission

- Adapt transmission control module:

  For 01M, see **BASIC SETTING, INITIATING**

  For 09G, see **BASIC SETTING, INITIATING**

- Test drive vehicle and interrogate fault memory.

Engine and transmission mountings, aligning

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 10-222 A Support assembly with legs 10-222 A/1 and Adapter 10-222 A/3

CAUTION: The assembly must be supported with support bar 10-222A before loosening bolts.

Locating Engine Mounting

Engine mounting

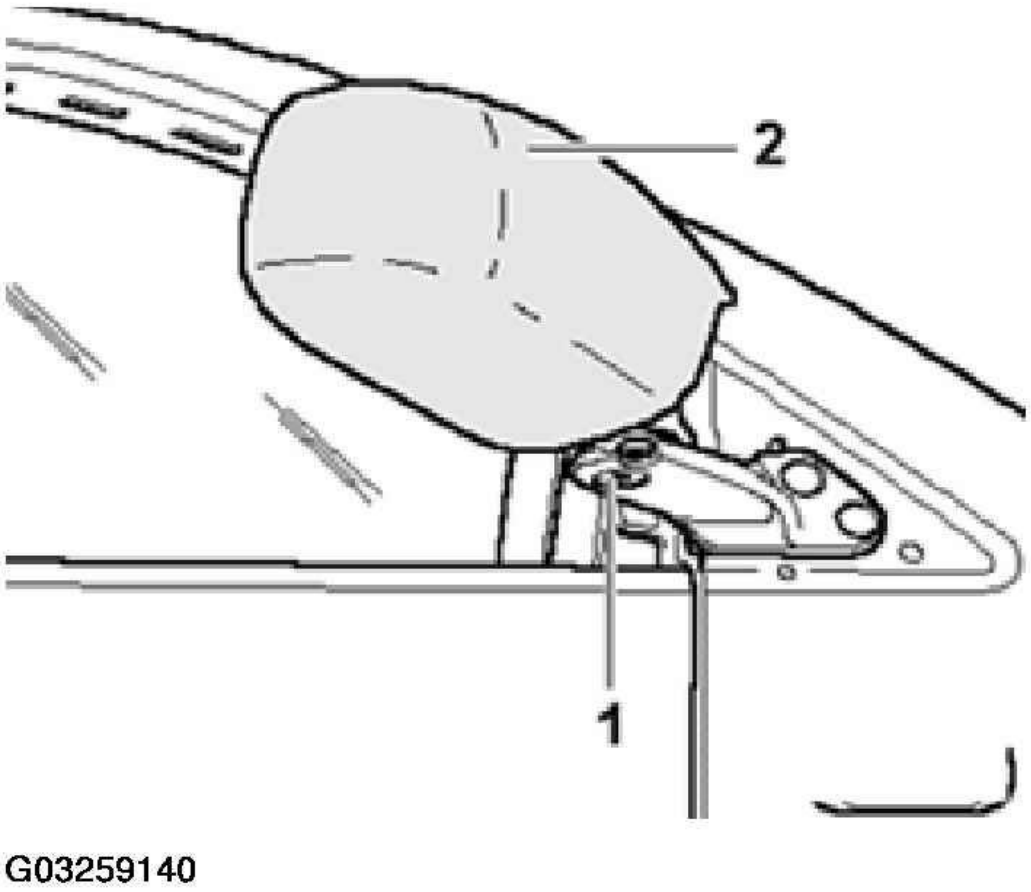


Fig. 15: Locating Engine Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

-a- = 14.0 mm

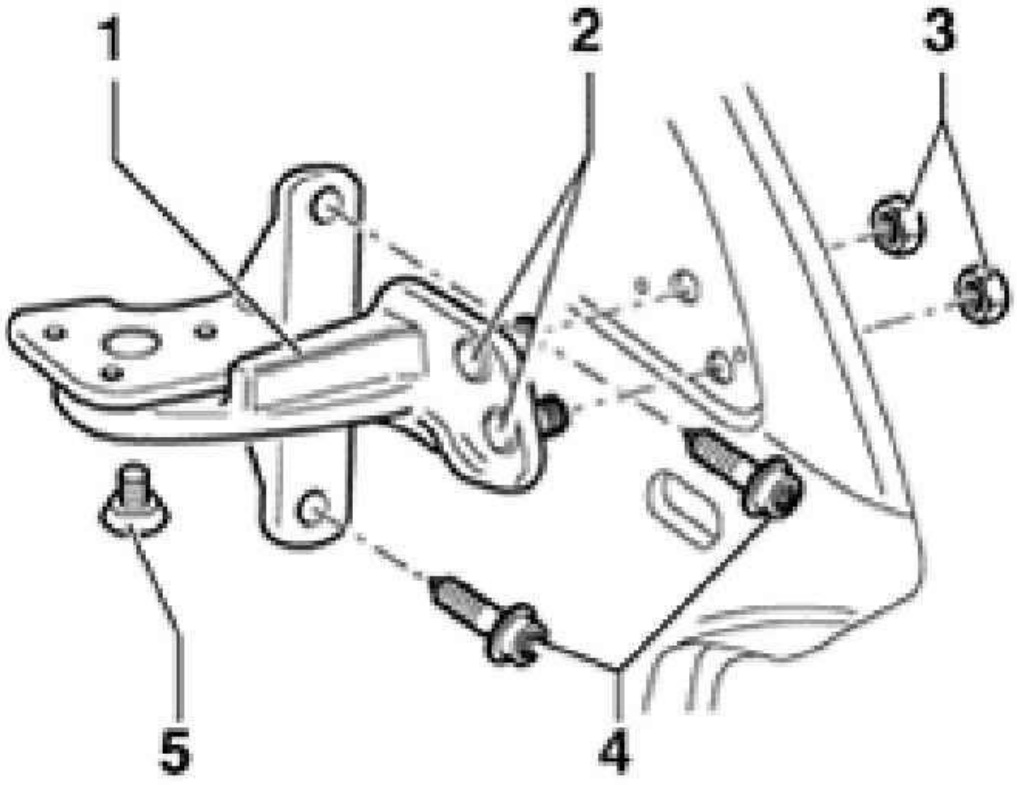
-b- = at least 10.0 mm

Both bolt heads 1 must be flush with edge -c-

Transmission mounting

Edges -a- and -b- must be parallel with one another

Locating Transmission Mounting



1 - Door hinge.

2 - Threaded stud.

3 - Nut (20 Nm + 90°).

4 - Bolt (20 Nm + 90°).

5 - Bolt (27 Nm).

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Fig. 16: Locating Transmission Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

-c- = 18...20 mm.

Torque settings. See **ASSEMBLY MOUNTING** , Assembly mountings.

Tightening torques

TORQUE SPECIFICATIONS

Bolted connections		**Torque setting**
Bolts, nuts(1)	M6	10 N.m
	M7	15 N.m
	M8	25 N.m
	M10	40 N.m
	M12	60 N.m
Torque converter to drive plate		(2)
Drive (axle) shaft		(3)

(1) Deviating from above: Engine to transmission connecting bolts. For 02J, see **TORQUE SPECIFICATIONS** . For 01M A/T, see **TORQUE SPECIFICATIONS** . For 09G, see **TORQUE SPECIFICATIONS** .

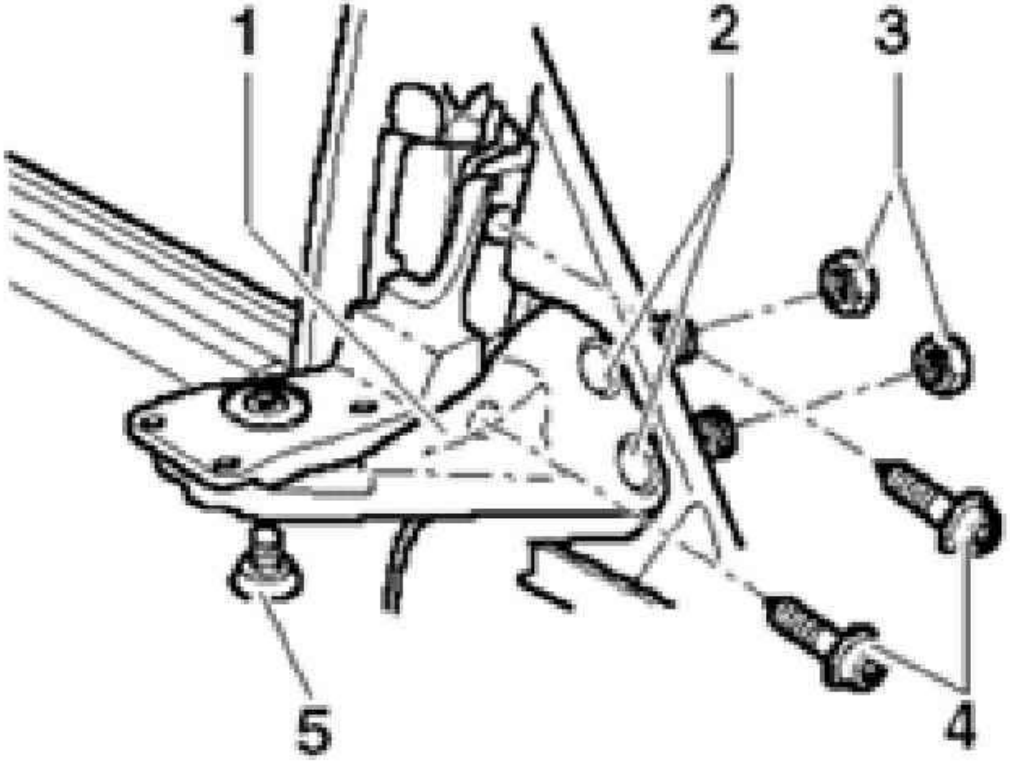
(2) For 01M, see **DRIVE PLATE** . For 09G, see either **DRIVE PLATE (1.8L)** or **DRIVE PLATE (2.0L)** .

(3) See **FRONT AXLE SHAFT** .

Assembly mounting

Tightening torques

Engine mounting



1 - Door hinge.

2 - Threaded stud.

3 - Nut (20 Nm + 90°).

4 - Bolt (20 Nm + 90°).

5 - Bolt (27 Nm).

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Fig. 17: Identifying Engine Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 17 .

1. Mounting to body

   40 N.m + 90°(1/4 turn)

   Replace bolts

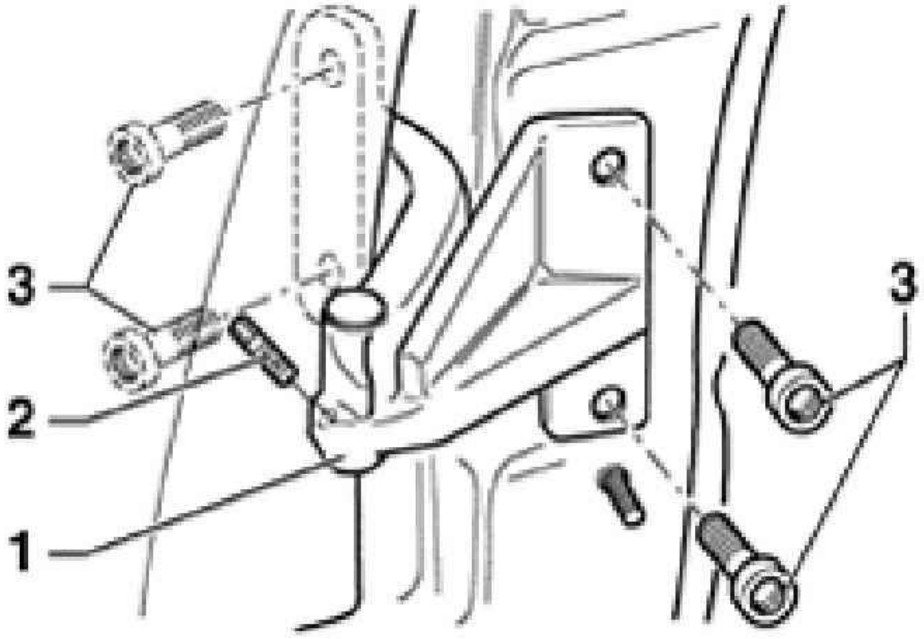
2. Mounting/bracket to body

   25 N.m

3. Mounting to engine mounting

   100 N.m

Transmission mounting



1 - Door hinge.

2 - Grub screw (13 Nm).

3 - Bolt (20 Nm + 90°).

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Fig. 18: Identifying Transmission Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 18 .

1. Mounting to body

   40N.m + 90° (1/4 turn)

   Replace bolts

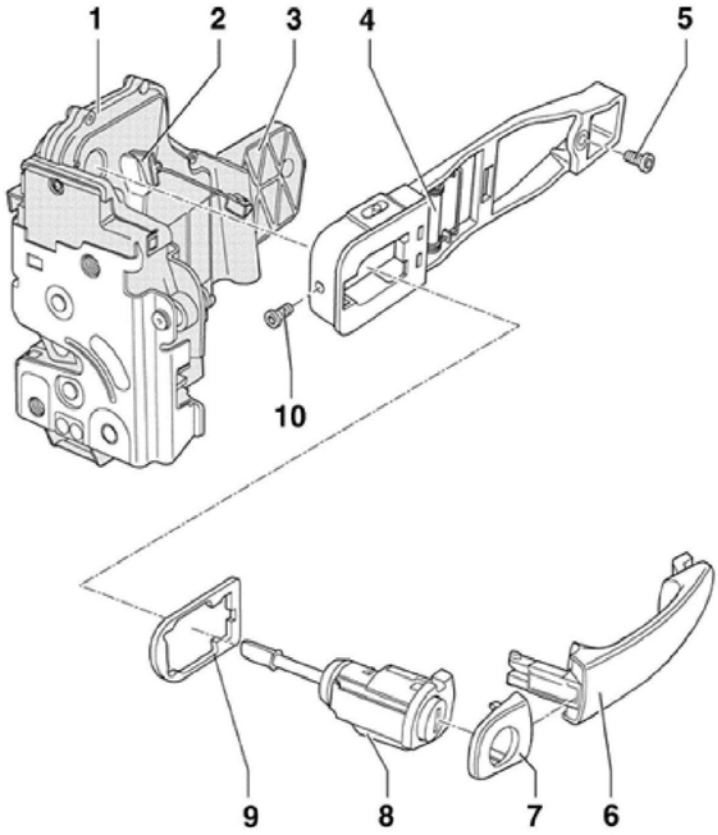
2. Mounting to body

   25 N.m

3. Mounting to transmission console

   100 N.m

Pendulum support



1 - Door lock
2 - Cable
3 - Retaining bracket
4 - Bearing bracket
5 - Multi-point socket head bolt
6 - Door handle
7 - Cover cap
8 - Lock cylinder housing
9 - Backing piece
10 - Multi-point socket head bolt

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Fig. 19: Identifying Pendulum Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 19 .

1. Pendulum support to transmission

   40 N.m + 90° (1/4 turn)

   Replace bolts

2. Pendulum support to transmission

   40 N.m + 90°(1/4 turn)

   Replace bolts

3. Pendulum support to subframe

   20 N.m + 90° (1/4 turn)

   Replace bolts

Additional information and assembly work on models with an air conditioning system

CAUTION: The air conditioning refrigerant circuit must not be opened.

NOTE: To prevent damage to the condenser as well as to the refrigerant lines/hoses, ensure that lines and hoses are not stretched, kinked or bent.

To facilitate removal and installation of the engine without having to open the refrigerant circuit:

- Remove retaining clamp(s) from refrigerant lines.
- Remove air conditioning compressor:

  See **CONDENSER, REMOVING AND INSTALLING** .

- Secure air conditioning compressor to towing eye so that refrigerant lines/hoses are not under tension.

  NOTE: Protect bumper with tape to prevent damage.

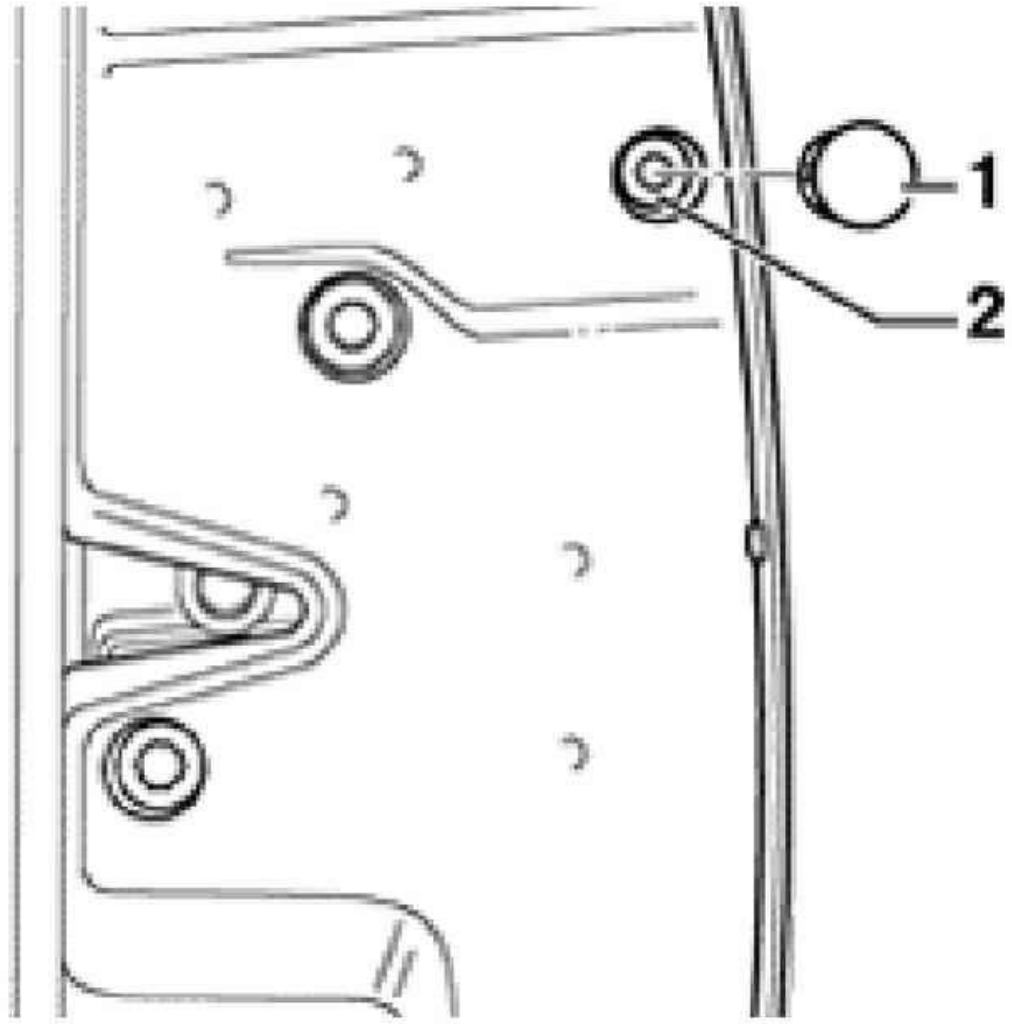

Fig. 20: Securing Air Conditioning Compressor To Towing Eye
Courtesy of VOLKSWAGEN OF AMERICA, INC.

ENGINE - CRANKSHAFT, CYLINDER BLOCK

ENGINE, DISASSEMBLING AND ASSEMBLING

NOTE: **If when repairing an engine, metal shavings or large amounts of small metal particles are found in the engine oil, caused for example by partial seizure of**

crankshaft or conrod bearings. Perform the following work sequences to prevent consequential damage once repairs are complete:

- **Thoroughly clean oil passages**
- **Replace oil spray jets**
- **Replace oil cooler**
- **Replace oil filter**

Only engine codes BDC, BGD

- The balancer shaft gear assembly must be adjusted. See **OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING** .

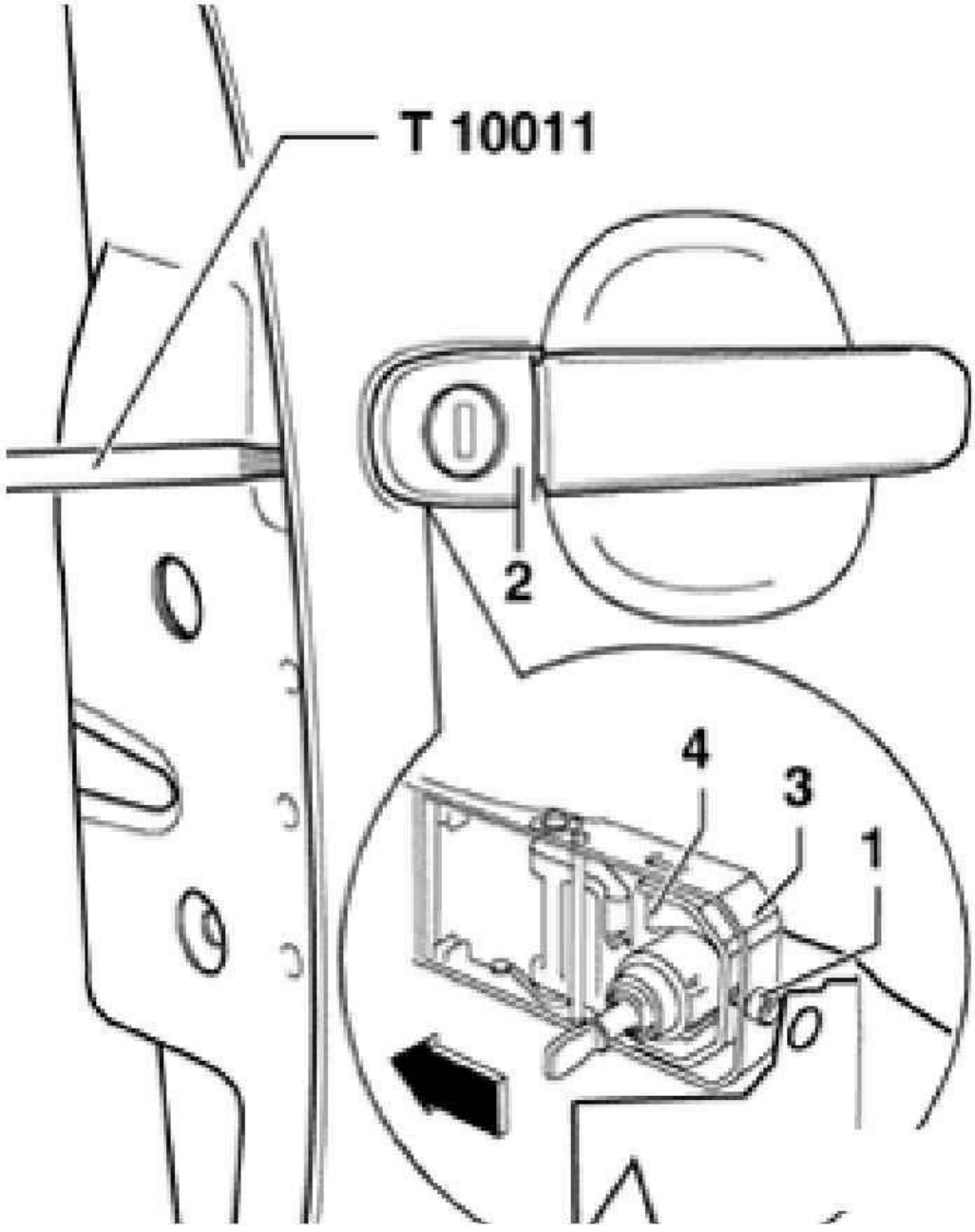

Fig. 21: Disassembling And Assembling Engine (Parts I & II)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

I. See **PART I**

II. See **PART II**

Part I

NOTE: The following list refers to items in Fig. 22 .

1. **45 N.m**
2. **Engine bracket**
3. **25 N.m**
4. **Retainer**
   - According to engine versions
5. **Retainer**
   - According to engine versions
6. **Clamp**
7. **10 N.m**
   - For engine cover
   - According to engine versions
8. **20 N.m**
   - According to engine versions
9. **Toothed belt guard-upper part**
10. **Toothed belt guard, center section**
11. **20 N.m**
12. **Washer**
13. **Tensioner**
    - Checking semiautomatic toothed belt tensioning roller. See **SEMI-AUTOMATIC TOOTHED BELT TENSIONING ROLLER, CHECKING** .
14. **Toothed belt**
    - Mark direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing, installing and tensioning. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING**
15. **Rear toothed belt guard**
16. **Washer**
17. **O-ring**
    - Replace
18. **Coolant pump**
    - Check for ease of movement

- If damaged or leaking renew complete
- Removing and installing. See **COOLANT PUMP, REMOVING AND INSTALLING** .

19. **15 N.m**
20. **Crankshaft toothed belt sprocket**
21. **90 N.m + 1/4 turn (90°) further**
    - Replace
    - Threads and shoulder must be free of oil and grease
    - Use counter support tool 3415 to loosen and tighten
22. **Toothed belt guard, lower part**
23. **10 N.m**
    - Replace
24. **Clutch**
    - For air conditioning compressor
25. **Belt pulley**
    - For power steering pump
26. **Ribbed belt**
    - Mark direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing and installing. See **RIBBED BELT, REMOVING AND INSTALLING** .
27. **Belt pulley/vibration damper**
    - Can only be installed in one position. Holes are offset
    - Note position when installing toothed (timing) belt. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .
28. **25 N.m**
29. **Tensioning element for ribbed belt**
    - Turn with open end wrench to loosen ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .

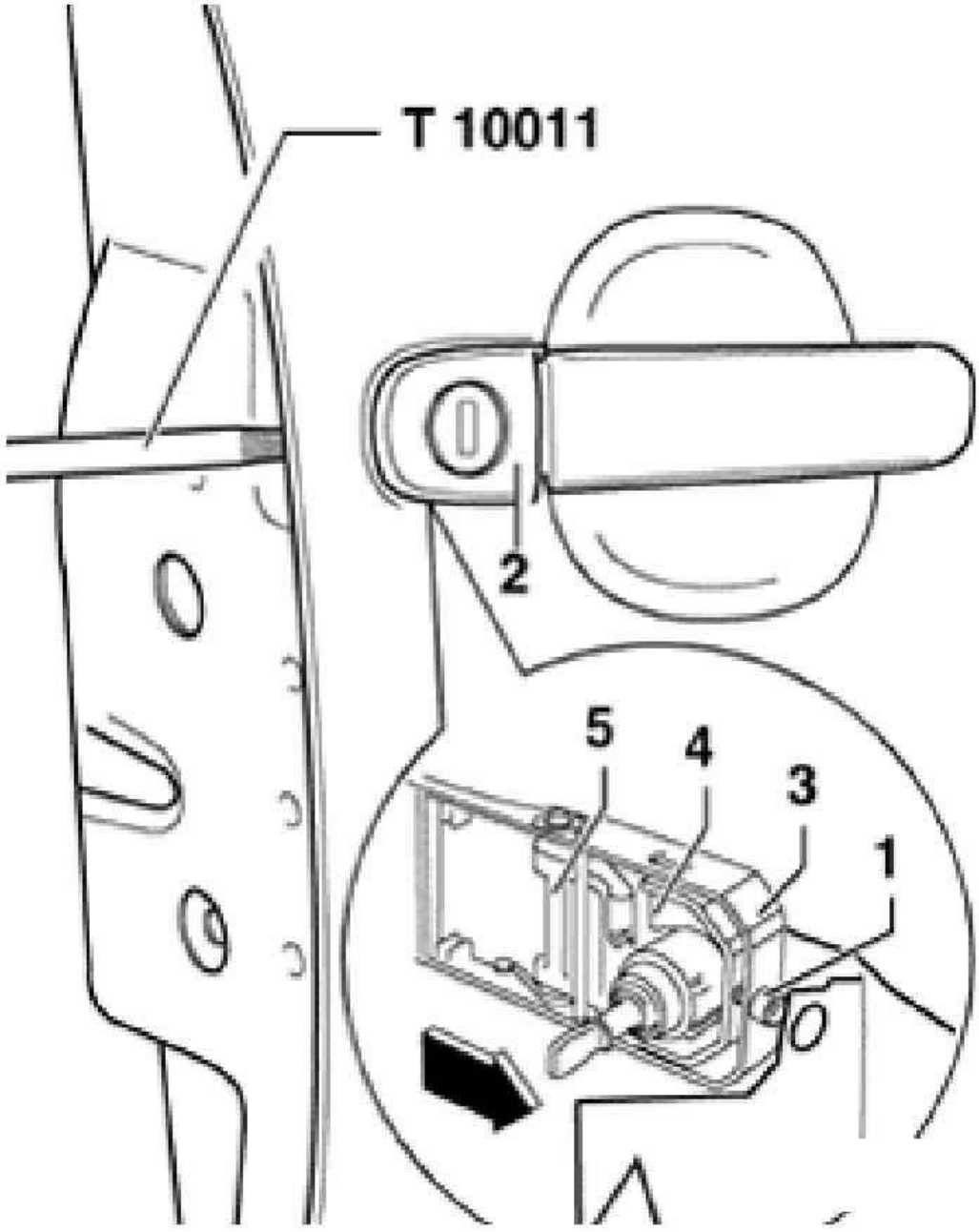

Fig. 22: Exploded View - Front Of Engine Components (Part I)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part II

NOTE: The following list refers to items in Fig. 23 .

1. **Knock Sensor (KS) 1 -G61-**
   - Gold plated contacts
2. **Connector**
   - For KS 1 -G61-
   - Gold plated contacts
   - Do not interchange

   See appropriate System Wiring Diagram article
3. **20 N.m**
   - Torque setting influences function of knock sensor
4. **Connector**
   - For KS 2 -G66-
   - Gold plated contacts
   - Do not interchange

   See appropriate System Wiring Diagram article
5. **Knock Sensor (KS) 2 -G66-**
   - Gold plated contacts
6. **Dipstick guide**
7. **Dipstick**
   - The oil level must not exceed the max. mark!
   - Markings. See **Fig. 136**
8. **Coolant pipe**
   - According to engine versions
   - Coolant hose connection diagram. See **COOLANT HOSE CONNECTION DIAGRAM** .
9. **25 N.m**
10. **Retainer**
    - For ignition coil
11. **Retainer**
    - According to engine versions
12. **10 N.m**
13. **Retainer**
    - According to engine versions

14. **Retainer**
    - According to engine versions
15. **Retainer**
    - According to engine versions
16. **Oil filter bracket**
    - Disassembling and assembling. See **Part II (Oil filter housing, disassembling and assembling)** .
17. **15 N.m + 1/4 turn (90°) further**
    - Replace
18. **Seal**
    - Replace
19. **Oil filter**
    - Loosen with strap wrench
    - Tighten by hand
    - Note instructions on filter when installing
20. **25 N.m**
21. **Oil cooler**
    - Coat contact surfaces to oil filter bracket outside the seal with AMV 188 100 02
    - Ensure clearance to adjacent components. See note at beginning of **ENGINE, DISASSEMBLING AND ASSEMBLING** .
22. **Seal**
    - Replace
23. **Engine speed sensor**
24. **Seal**
    - Replace if damaged
25. **40 N.m**
26. **Connecting unions**
27. **15 N.m**
28. **Coolant thermostat**
    - Checking: Heat up thermostat in water
    - Starts to open at approx. 86° C
    - Opening stroke: min. 7 mm
    - Removing and installing. See **THERMOSTAT, REMOVING AND INSTALLING** .
29. **Hex socket head bolt**
    - Torque setting:

      See **CONDENSER, REMOVING AND INSTALLING** .

30. **Compact bracket**

- For ribbed belt tensioning roller, Generator, power steering pump and air conditioning compressor

  See **CONDENSER, REMOVING AND INSTALLING** .

31. **Cylinder block**
    - Removing and installing sealing flange and flywheel/drive plate. See **SEALING FLANGES AND FLYWHEEL/DRIVE PLATE, REMOVING AND INSTALLING** .
    - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING** .
    - Disassembling and assembling piston and conrod. See **PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING** .
    - Engine codes BDC, BGD: Removing and installing oil pump with balancer shaft gear assembly. See **OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING** .

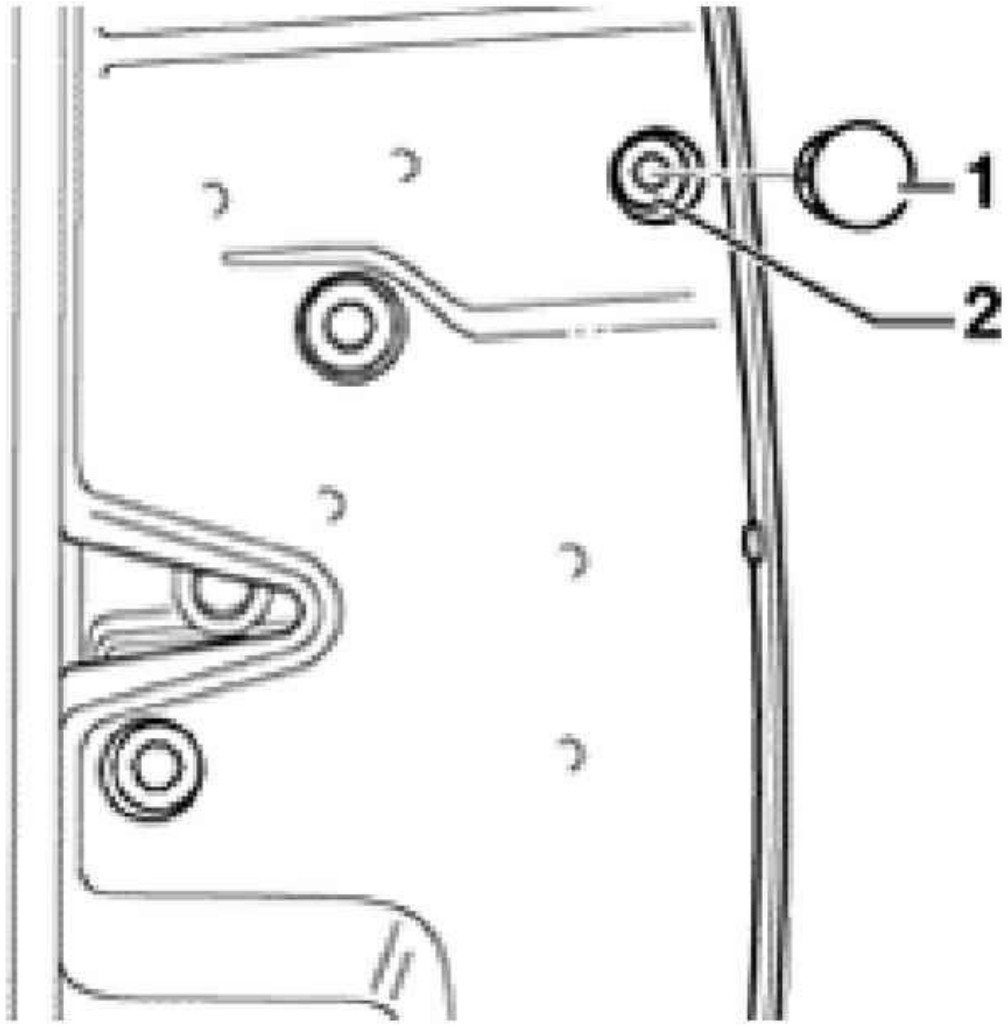

Fig. 23: Exploded View - External Engine Block Components (Part II)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Ribbed belt, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- T20167 Locking pin

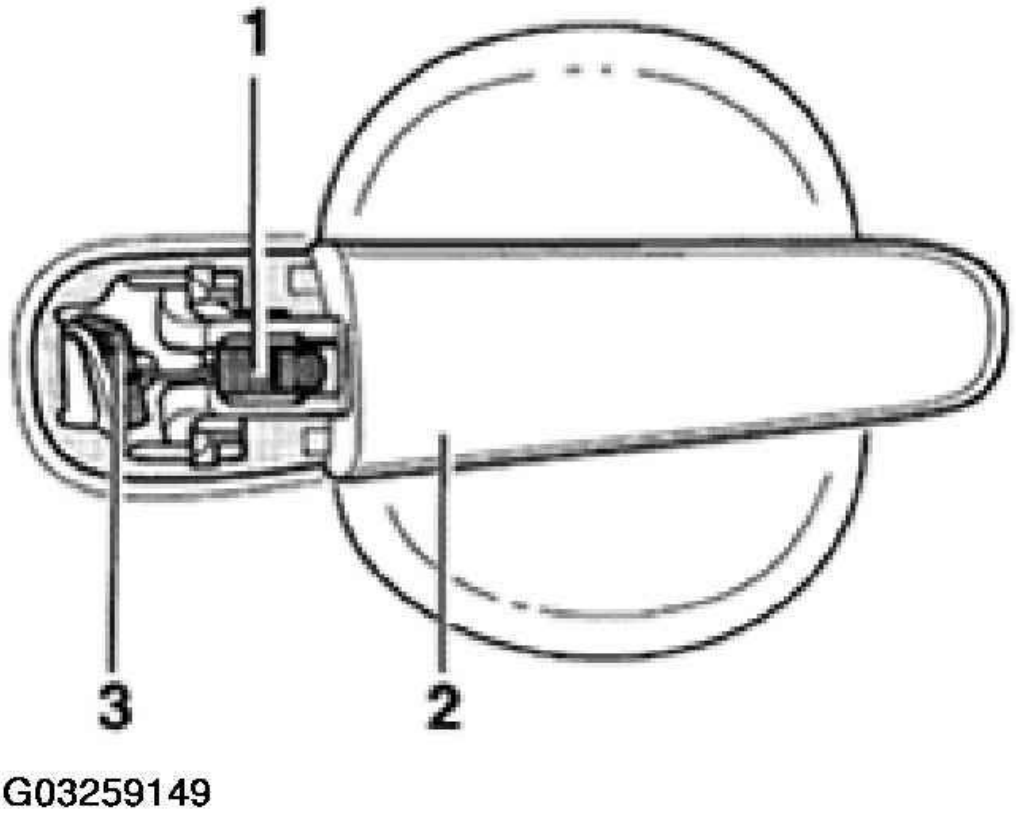

Fig. 24: Identifying Special Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove right side insulation tray:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

- Remove engine cover.
- Mark direction of rotation of ribbed belt.
- Turn tensioning device in direction of arrow to relieve tension on ribbed belt.

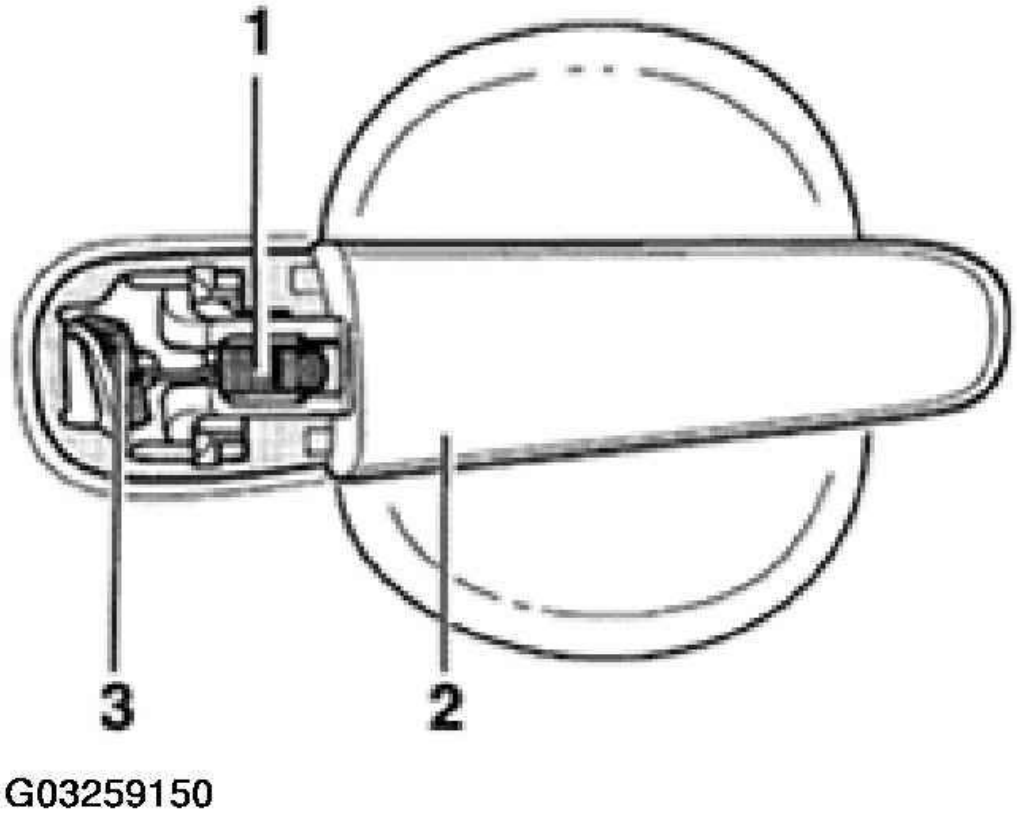

Fig. 25: Relieving Tension On Ribbed (Drive) Belt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Lock tensioning element using locking pin T20167

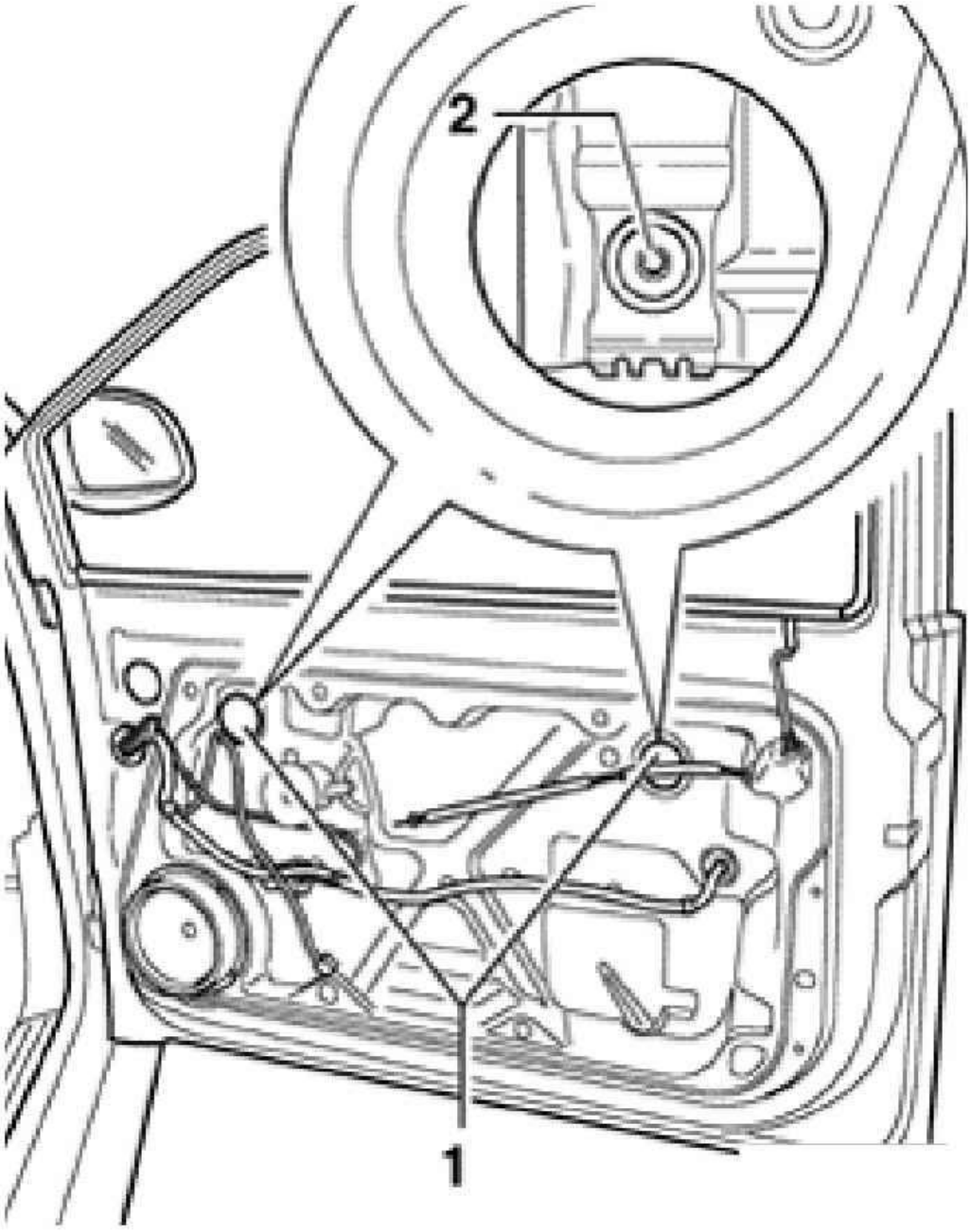

Fig. 26: Locking Ribbed (Drive) Belt Tensioning Element
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove ribbed belt.

Installing

- Install in reverse order.

NOTE:

- **Ensure, before installing ribbed belt, that all ancillaries (Generator, air conditioning compressor, power steering pump) are secured tightly.**
- **When installing the ribbed belt observe belt direction of rotation and that the belt is seated correctly in the belt pulleys.**
- **On models which do not have an air conditioning system place the ribbed belt over the Generator pulley last.**
- **For models with an air conditioning system place the ribbed belt over the air conditioning compressor last.**

After completing repairs always:

- Start engine and check belt running.

Belt drive without air conditioning compressor

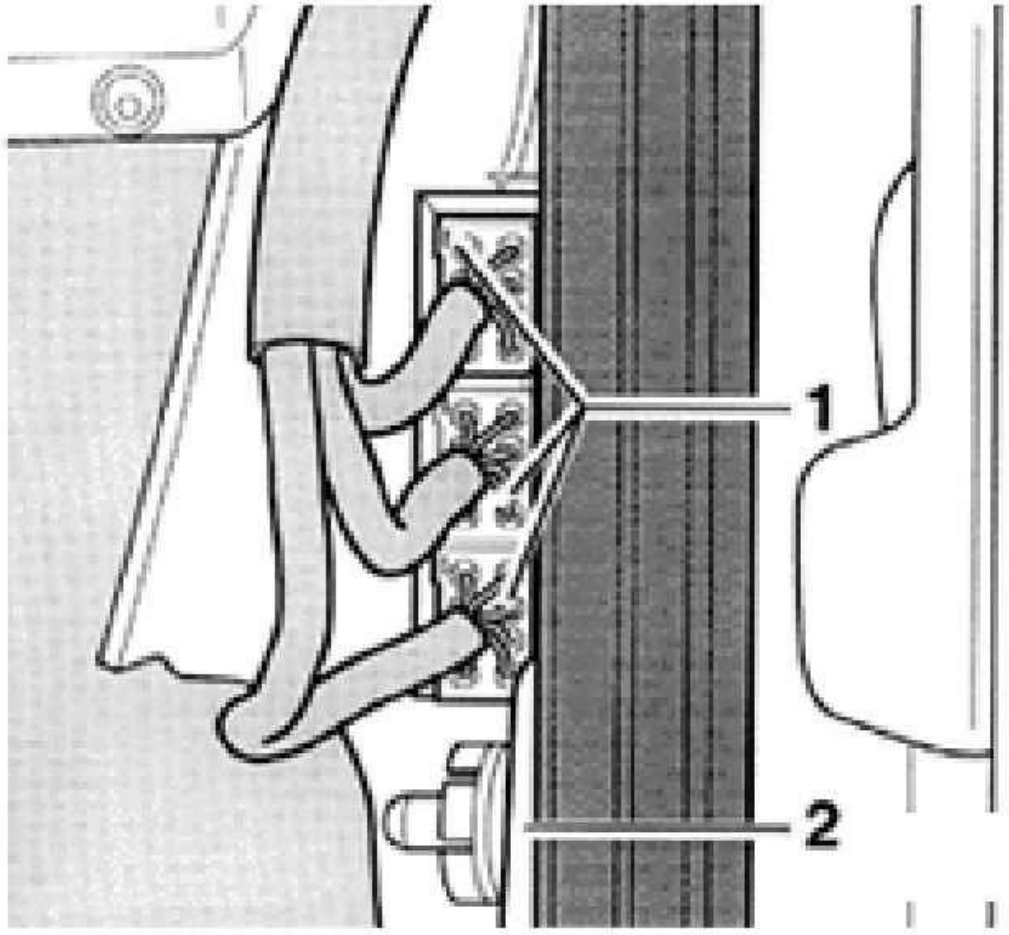

Fig. 27: Identifying Belt Drive Without Air Conditioning Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Belt drive with air conditioning compressor

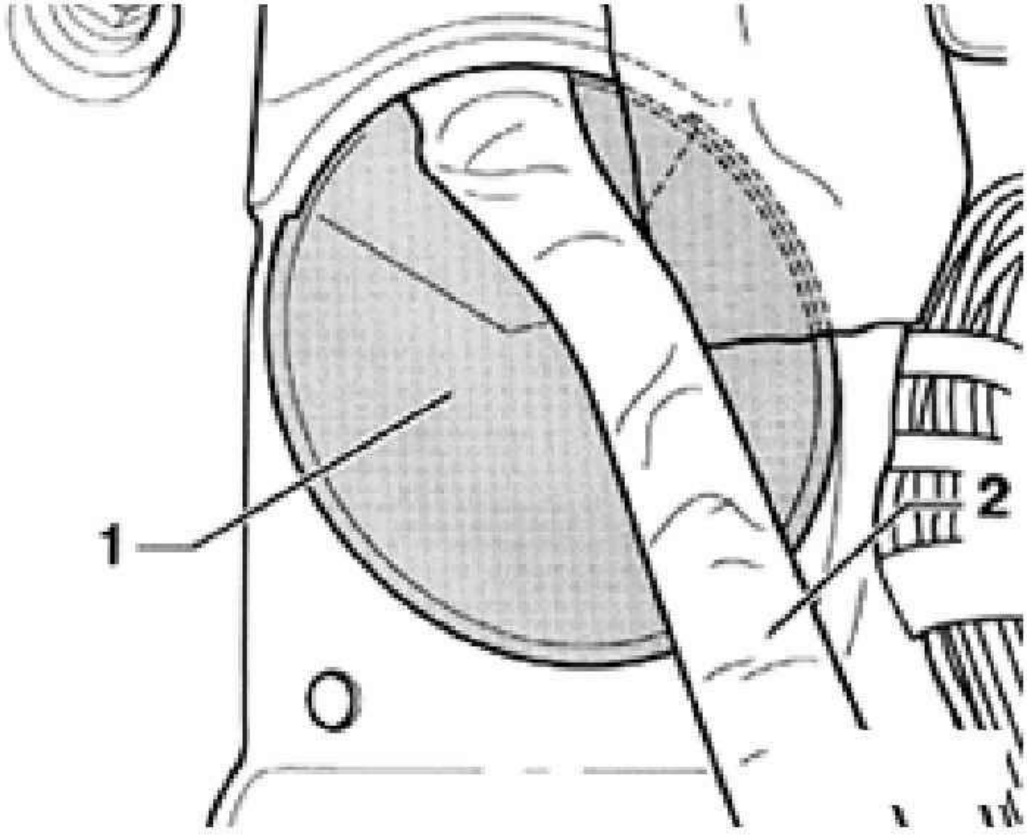

Fig. 28: Identifying Belt Drive With Air Conditioning Compressor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

SEALING FLANGES AND FLYWHEEL/DRIVE PLATE, REMOVING AND INSTALLING

Engine codes AEG, AVH, AZG, BEV

NOTE: The following list refers to items in Fig. 29 .

1. **90 N.m + 1/4 turn (90°) further**
   - Replace
   - Threads and shoulder must be free of oil and grease
   - Use counterhold tool 3415 to loosen and tighten
2. **Crankshaft toothed belt sprocket**

3. **15 N.m**
4. **Seal**

   PTFE sealing rings:

   - Do not additionally oil or grease oil seal sealing lip

     Coil spring seals:

   - Oil or grease lightly oil seal sealing lip

     NOTE: Differences between PTFE sealing ring and coil spring seals. See Fig. 31 .

   - Replace. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING** .
5. **Sealing flange**
   - Remove oil sump to remove and install
   - Must be located on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
6. **Cylinder block**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING** .
   - Disassembling and assembling piston and connecting rod. See **PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING** .
7. **60 N.m + 1/4 turn (90°) further**
   - Replace
8. **Flywheel/drive plate**
   - To remove and install flywheel counter-hold with 3067
   - Removing and installing drive plate. See **DRIVE PLATE, REMOVING AND INSTALLING** .
9. **Intermediate plate**
   - Must be located on dowel sleeves. See **Fig. 32** .
   - Do not damage/bend when assembling
10. **Sealing flange with oil seal**
    - Only replace complete
    - Use protective sleeve supplied when installing
    - Remove oil sump to remove and install
    - Before installing, remove oil remains from crankshaft journal with a clean cloth.
    - Remove protective sleeve first after sealing flange has been slid onto crankshaft journal

PTFE sealing rings:

- Do not additionally oil or grease oil seal sealing lip

Coil spring seals:

- Oil or grease lightly the seal sealing lip
- Differences between PTFE sealing ring and coil spring seals. See **Fig. 31** .

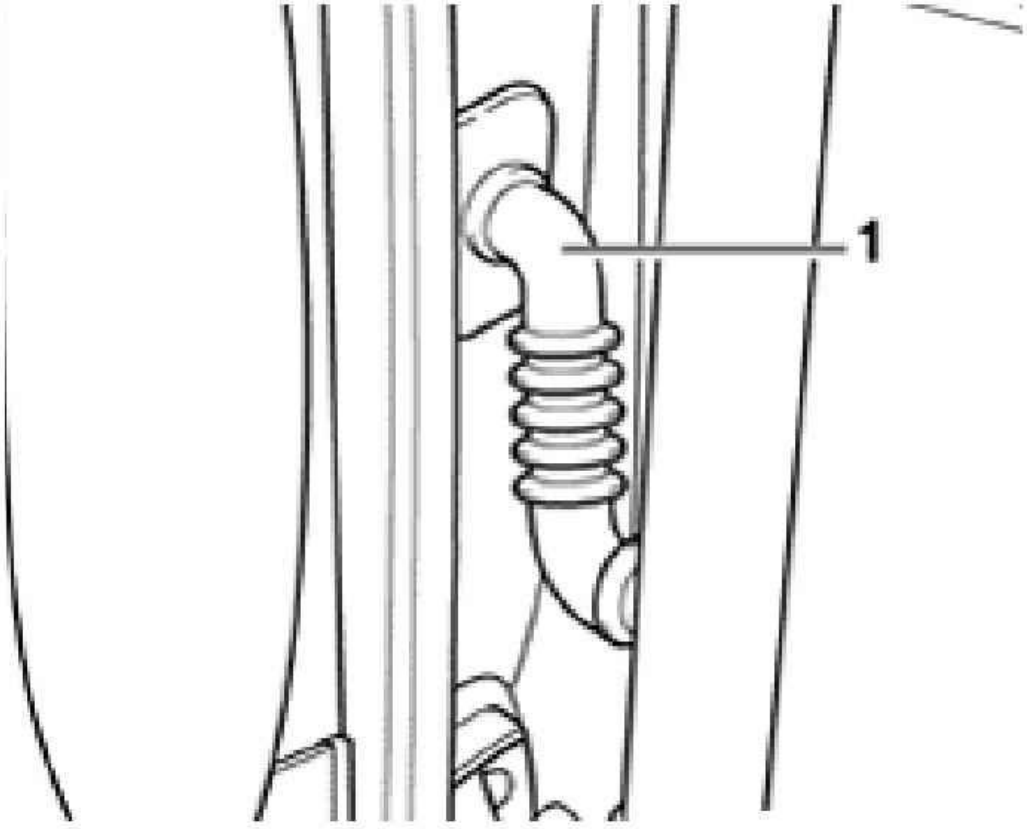

Fig. 29: Sealing Flanges & Flywheel/Drive Plate (Engine Codes AEG, AVH, AZG, BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine codes BDC, BGD

NOTE: The following list refers to items in Fig. 30 .

1. **90 N.m + 1/4 turn (90°) further**
   - Replace
   - Threads and shoulder must be free of oil and grease
   - Use counter support tool 3415 to loosen and tighten
2. **Crankshaft toothed belt sprocket**
3. **15 N.m**
4. **Seal**

   PTFE sealing rings:
   - Do not additionally oil or grease oil seal sealing lip

   Coil spring seals:
   - Oil or grease lightly the seal sealing lip
   - Differences between PTFE sealing ring and coil spring seals, see **Fig. 31** .
   - Replacing. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING** .
5. **Sealing flange**
   - Remove oil sump to remove and install
   - Must be seated on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
6. **Cylinder block**
   - Removing and installing crankshaft. See **CRANKSHAFT, REMOVING AND INSTALLING** .
   - Disassembling and assembling piston and connecting rod. See **PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING** .
7. **60 N.m + 1/4 turn (90°) further**
   - Replace
8. **Flywheel/drive plate**
   - Counter support with 3067 when removing and installing flywheel
   - Removing and installing drive plate. See **DRIVE PLATE, REMOVING AND INSTALLING** .
9. **Intermediate plate**
   - Must be located on dowel sleeves. See **Fig. 32** .
   - Do not damage/bend when assembling
10. **Sealing flange with oil seal**
    - Only replace complete
    - Use protective sleeve supplied when installing

- Remove oil sump to remove and install
- Before installing, remove oil remains from crankshaft journal with a clean cloth.
- Remove protective sleeve first after sealing flange has been slid onto crankshaft journal
- PTFE sealing rings: Do not additionally oil or grease oil seal sealing lip
- Coil spring seals: Oil or grease lightly the seal sealing lip
- Differences between PTFE sealing ring and coil spring seals. See **Fig. 31**

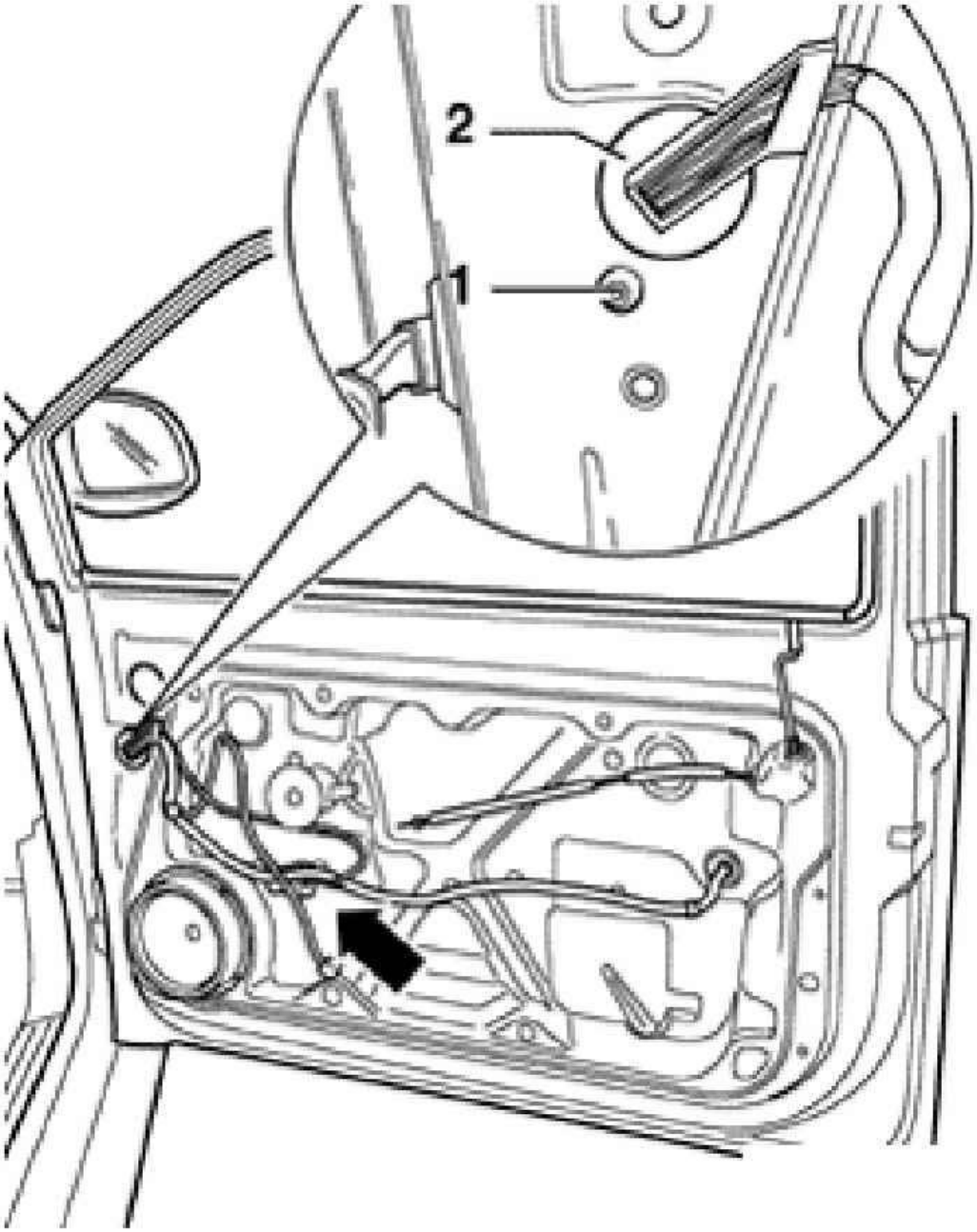

Fig. 30: Sealing Flanges And Flywheel/Drive Plate (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Differences Between Sealing Rings

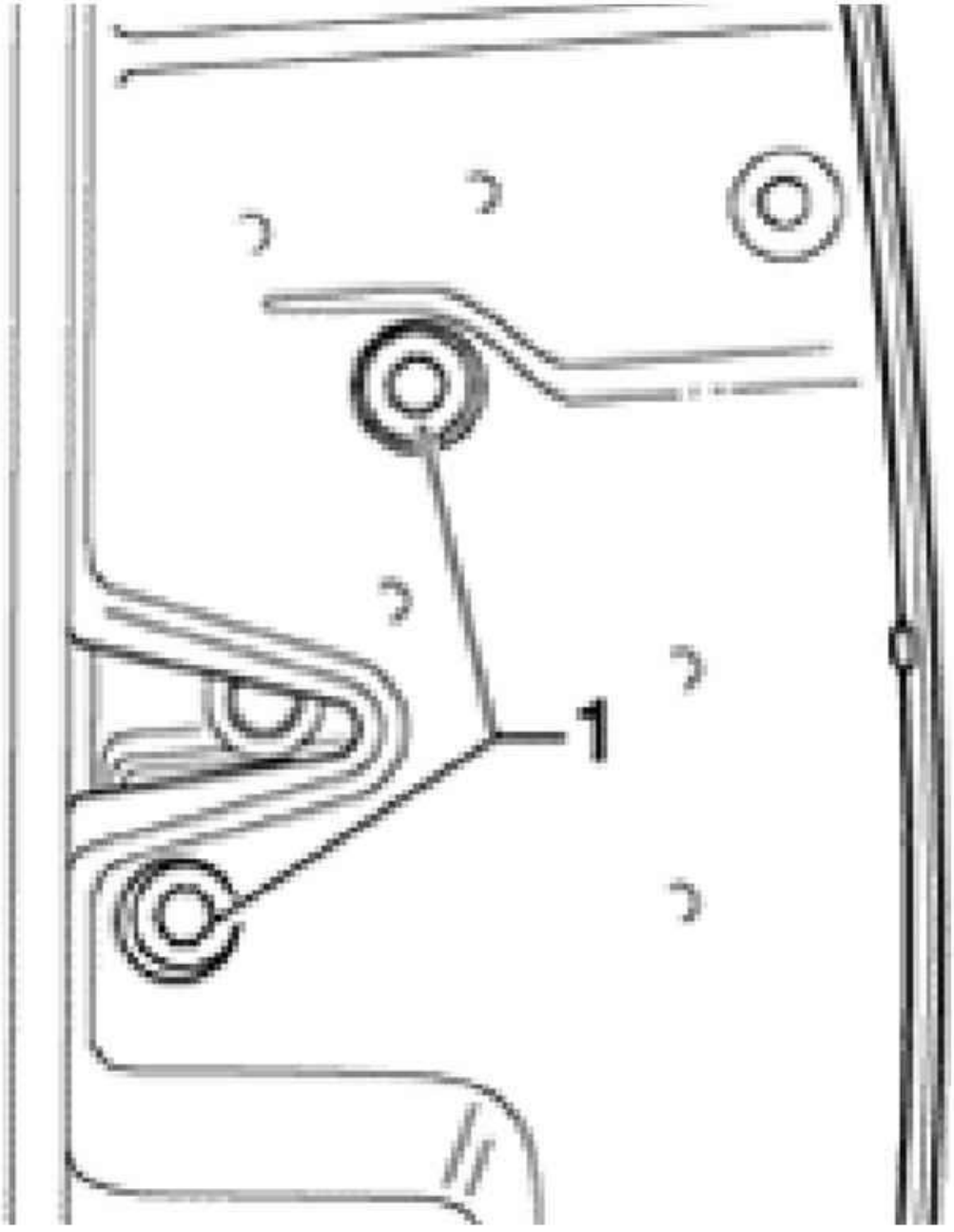

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Fig. 31: Identifying Differences Between Sealing Rings
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **For clarity reasons, individual sealing rings for sealing flange are also shown. Only replace sealing flange complete with oil seal.**
- **A PTFE seal (Teflon) -2- is gradually being introduced instead of the inner coil spring seal -1-. This has a wider sealing lip.**
- **PTFE oil seals are installed free of oil and grease.**
- **A radial shaft seal of older design (with annular spring) may be replaced with a PTFE oil seal, but not vice versa.**
- **When a PTFE seal is installed, then only such a seal may be installed as a replacement part!**

Installation position of intermediate plate

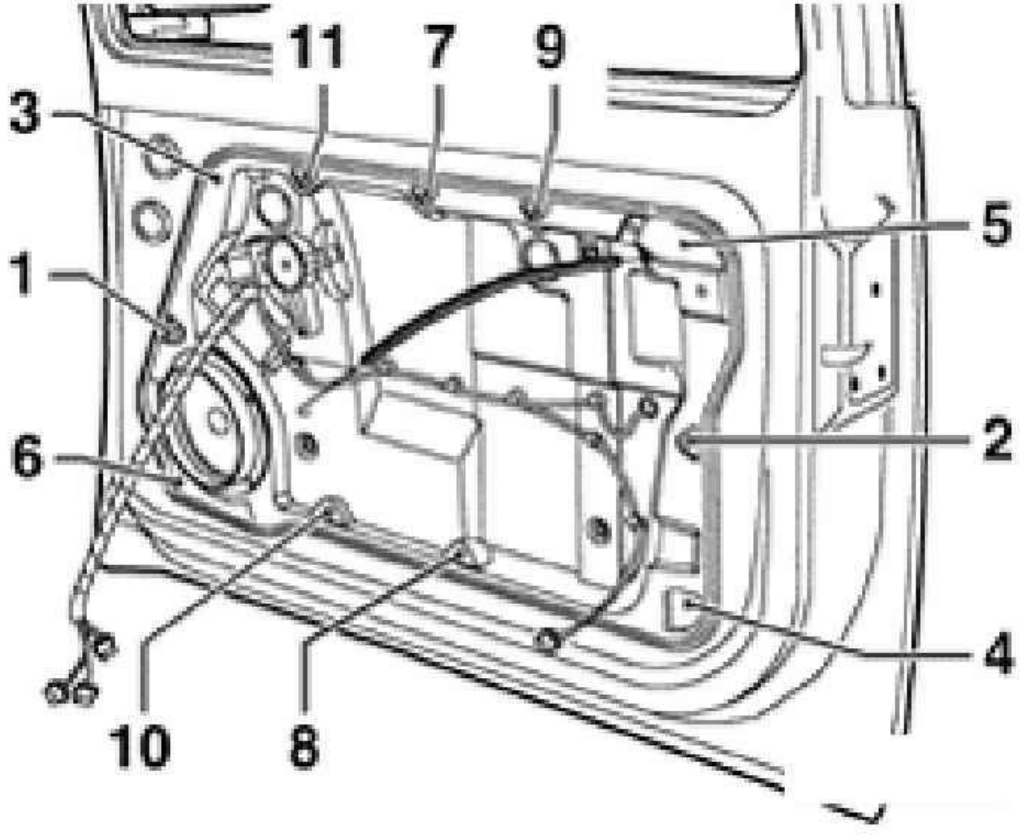

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Fig. 32: Installing Intermediate Plate Onto Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install intermediate plate onto sealing flange and slide onto dowel sleeves (arrows).

Crankshaft oil seal - pulley end, replacing

Special tools, equipment, testers, measuring instruments and auxiliary items required

For coil spring seals:

- 2080 A Fitting sleeve
- 3203 Oil seal extractor
- 3266 Fitting sleeve
- 3415 Counterhold
- V.A.G 1331 Torque wrench (5 ... 50 N.m)
- V.A.G 1332 Torque wrench (40 ... 200 N.m)

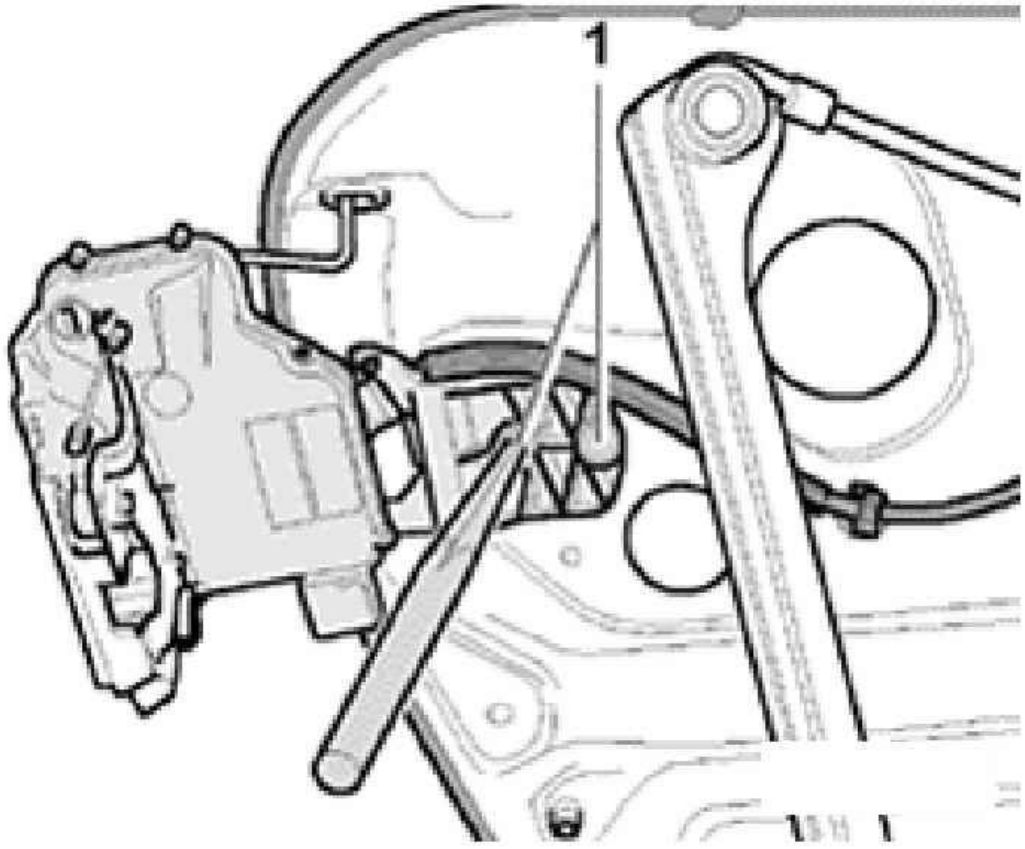

Fig. 33: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

For PTFE seals:

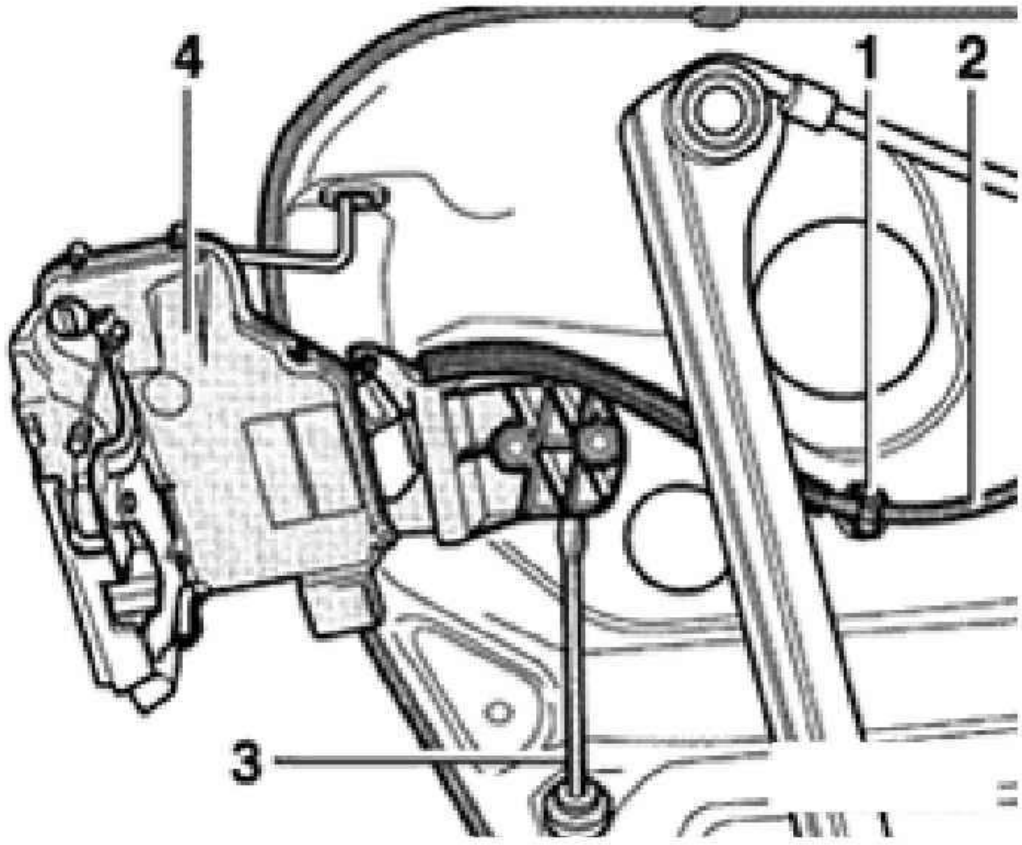

Fig. 34: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3203 Oil seal extractor
- 3415 Counter support
- T10053 Assembly device
- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)

Removing

- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove toothed (timing) belt. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .

- Remove crankshaft toothed belt pulley. To do this counter support sprocket with 3415.

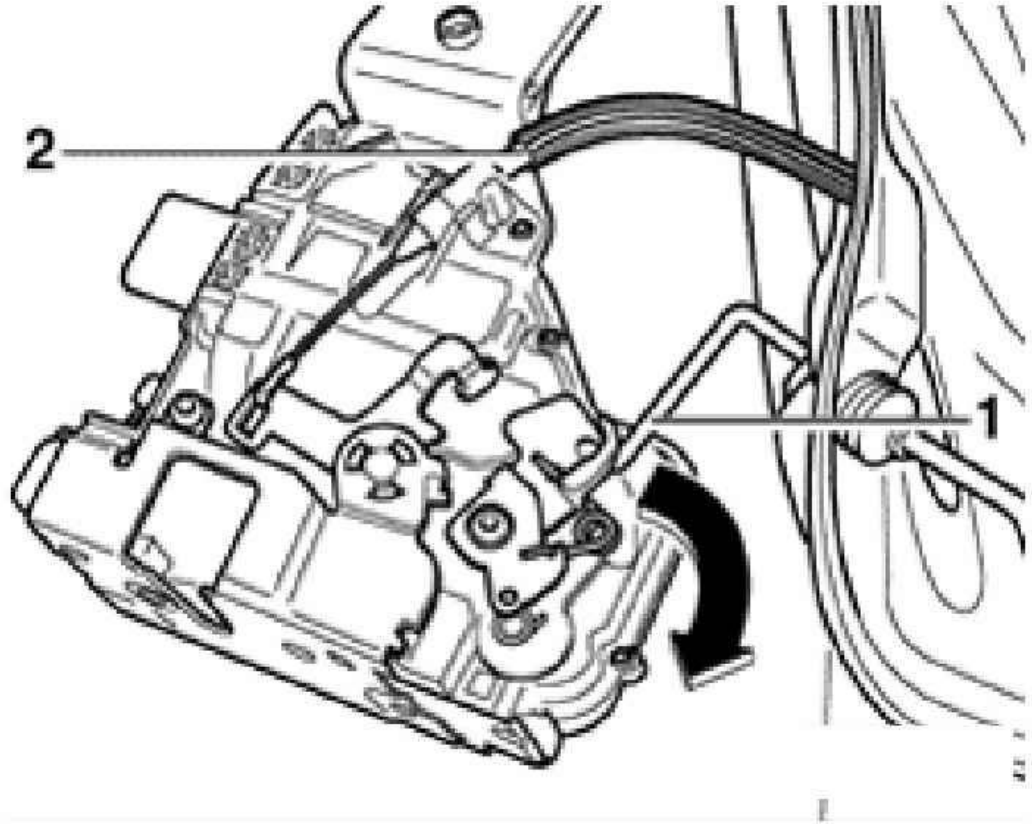

Fig. 35: Removing Crankshaft Toothed Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- To guide seal extractor, thread center bolt into crankshaft onto limit stop by hand.

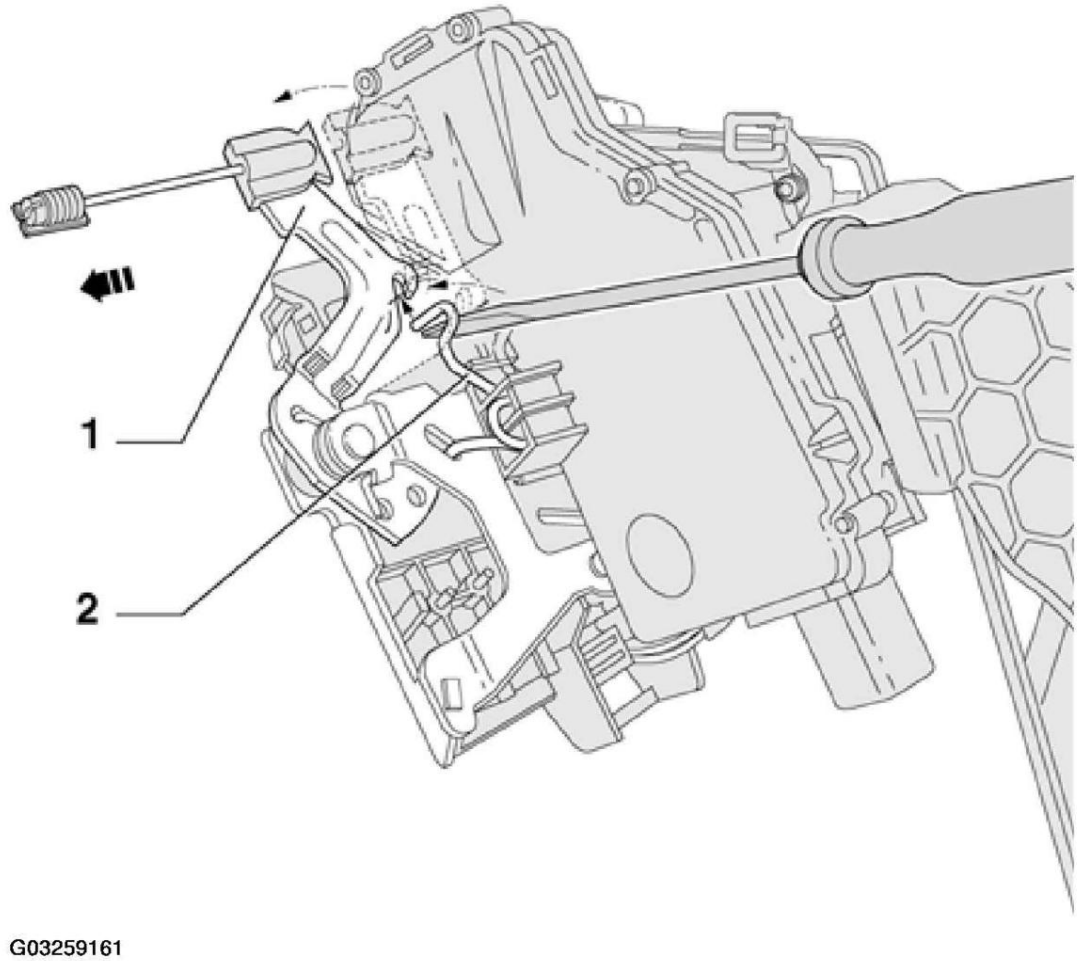

Fig. 36: Installing Bolt Into Crankshaft
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Unscrew inner part of oil seal extractor 3203 nine turns (approx. 20 mm) out of outer part and lock with knurled screw.
- Lubricate threaded head of oil seal extractor 3203, place it in position and exerting firm pressure screw it as far as possible into oil seal.
- Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.

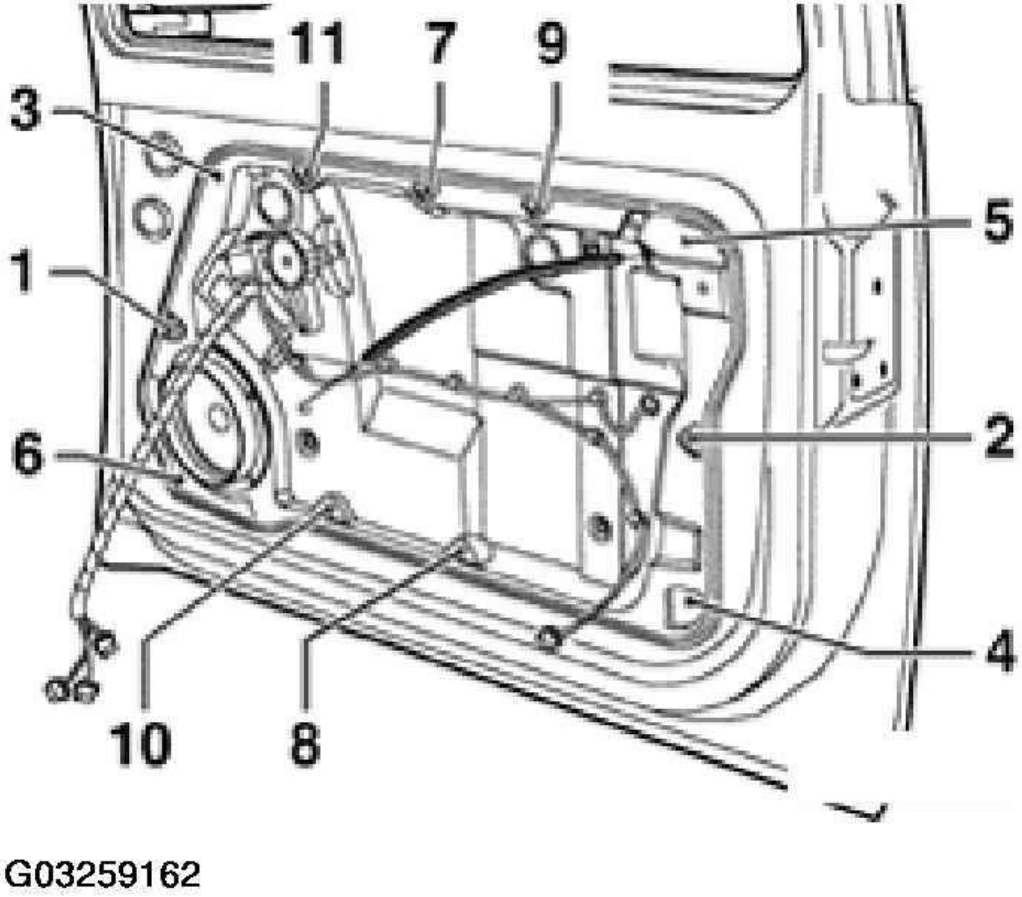

Fig. 37: Removing Crankshaft Oil Seal (Pulley End)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

NOTE: A PTFE seal (Teflon) -2- is gradually being introduced instead of the inner coil spring seal -1-. This has a wider sealing lip. PTFE oil seals are installed free of oil and grease. When a PTFE seal is installed, then only such a seal may be installed as a replacement part!

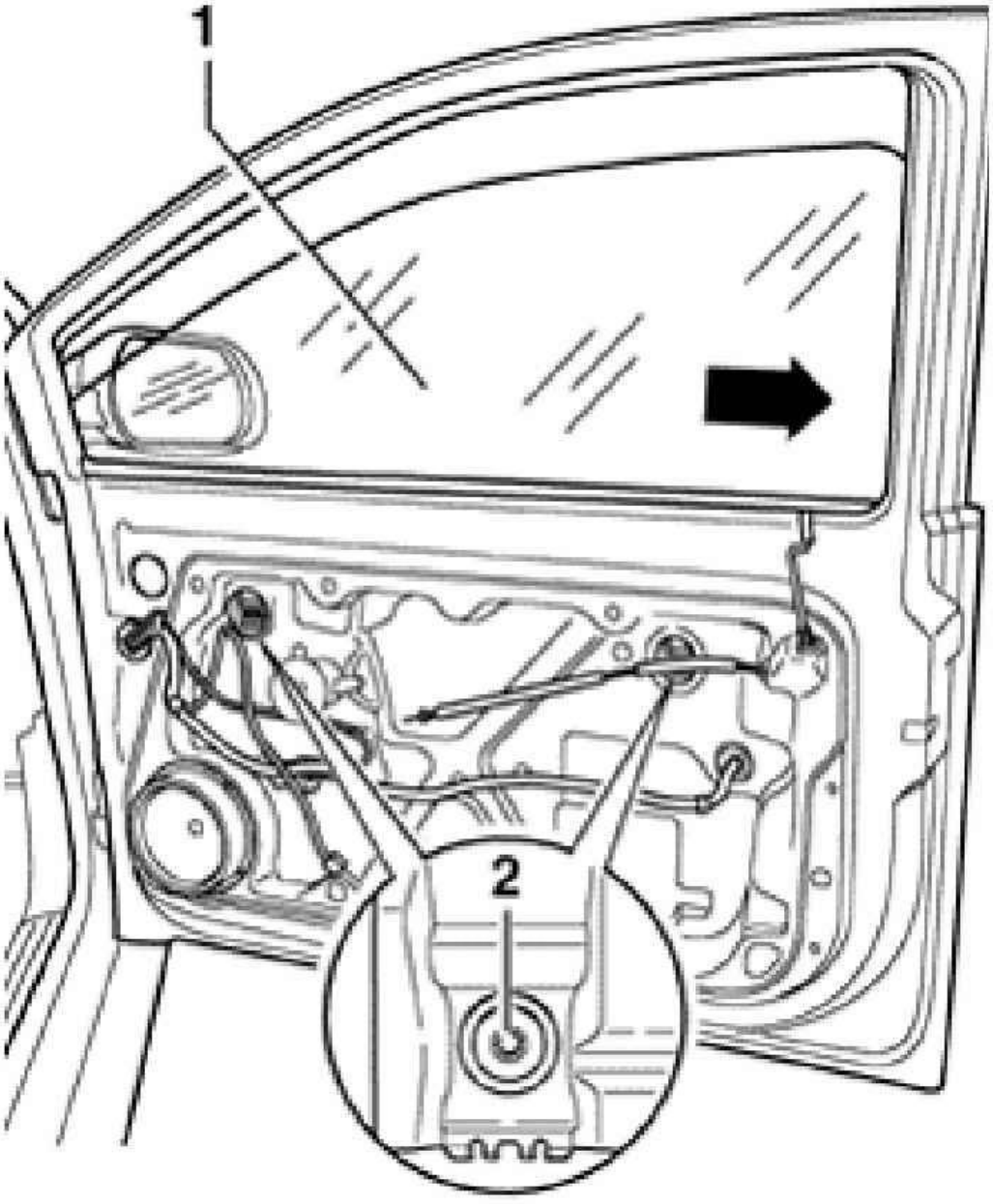

Fig. 38: Identifying Oil Seals (Crankshaft, Pulley End)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Before installing, remove oil remains from crankshaft journal with a clean cloth.

PTFE sealing rings

- Mount guide sleeve T10053/1 onto crankshaft journal.

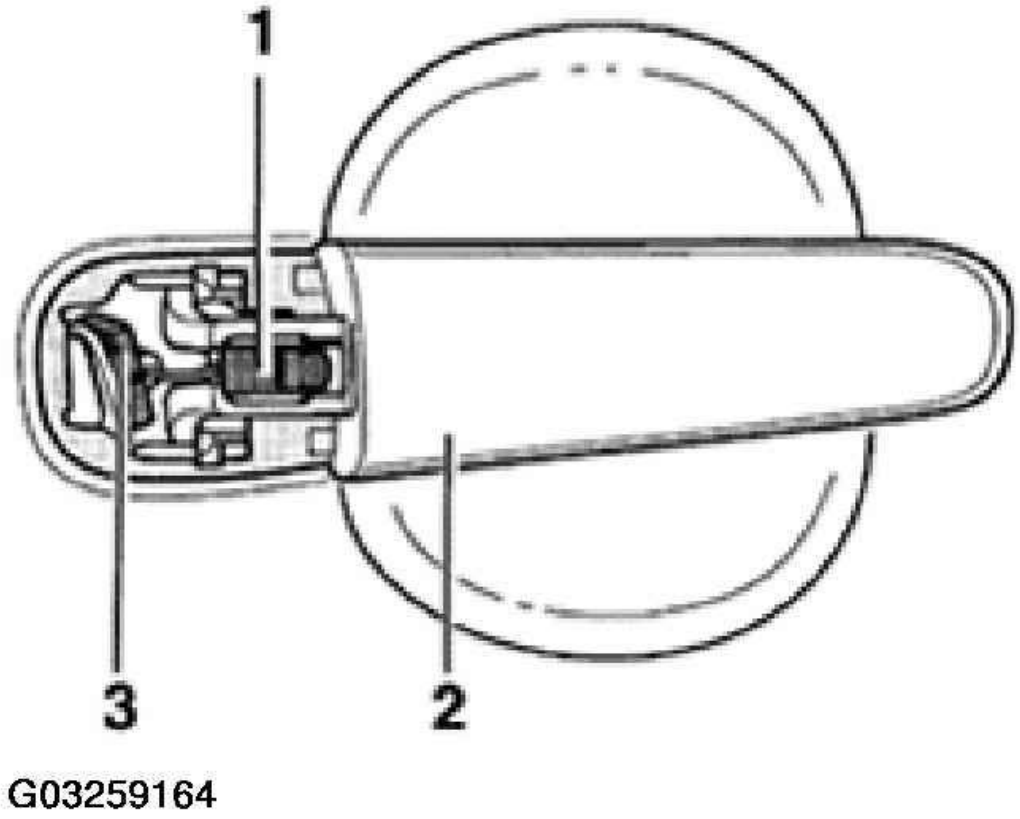

Fig. 39: Mounting Guide Sleeve Onto Crankshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve onto crankshaft journal.
- Press in oil seal onto limit stop using press sleeve T10053 and bolt T10053/2 (M16 x 1.5 x 60).

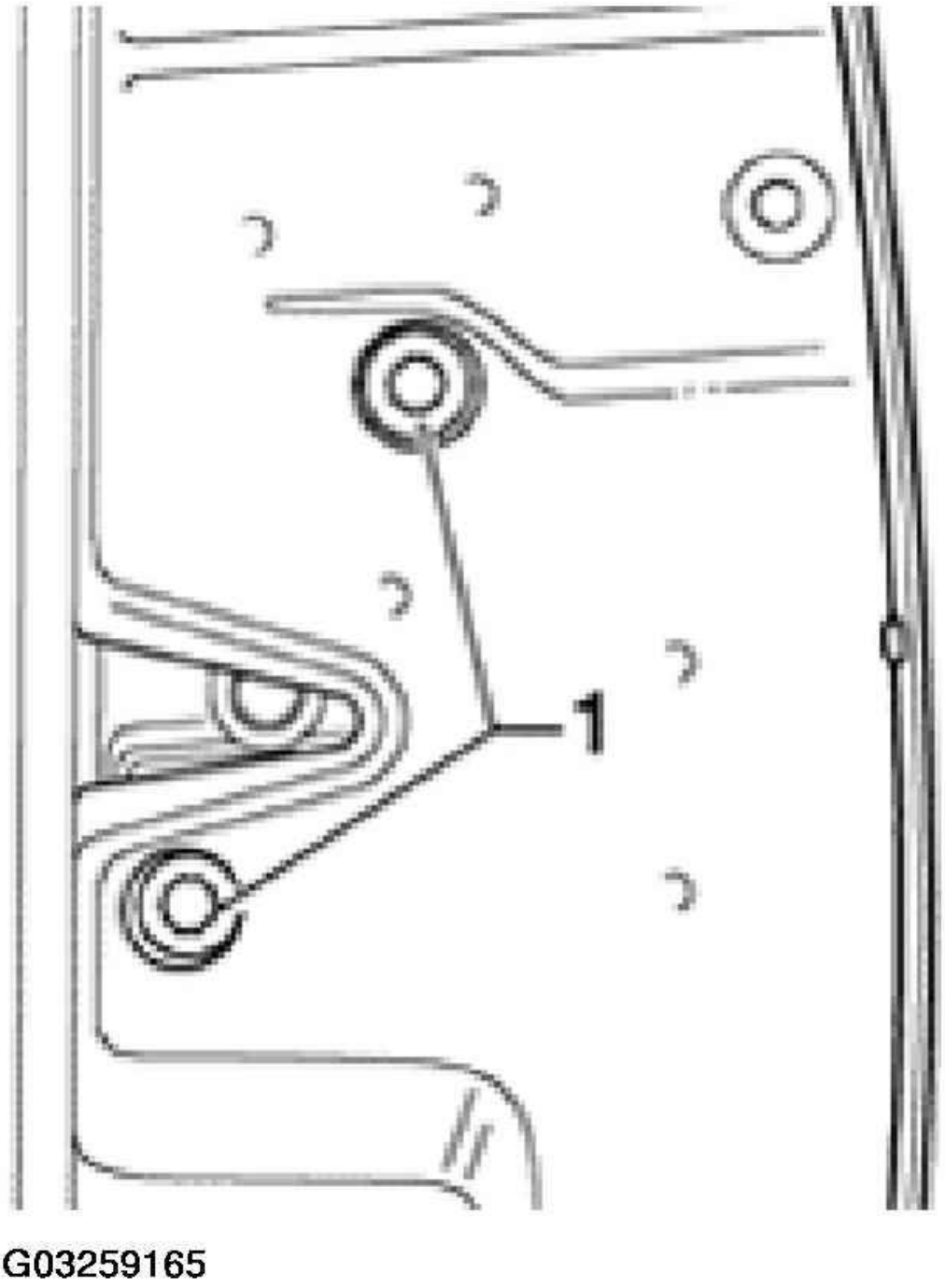

Fig. 40: Pressing In Crankshaft Front Oil Seal (PTFE)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Coil spring seals

- Lightly oil sealing lip of oil seal.
- Mount guide sleeve from 2080 A onto crankshaft journal.

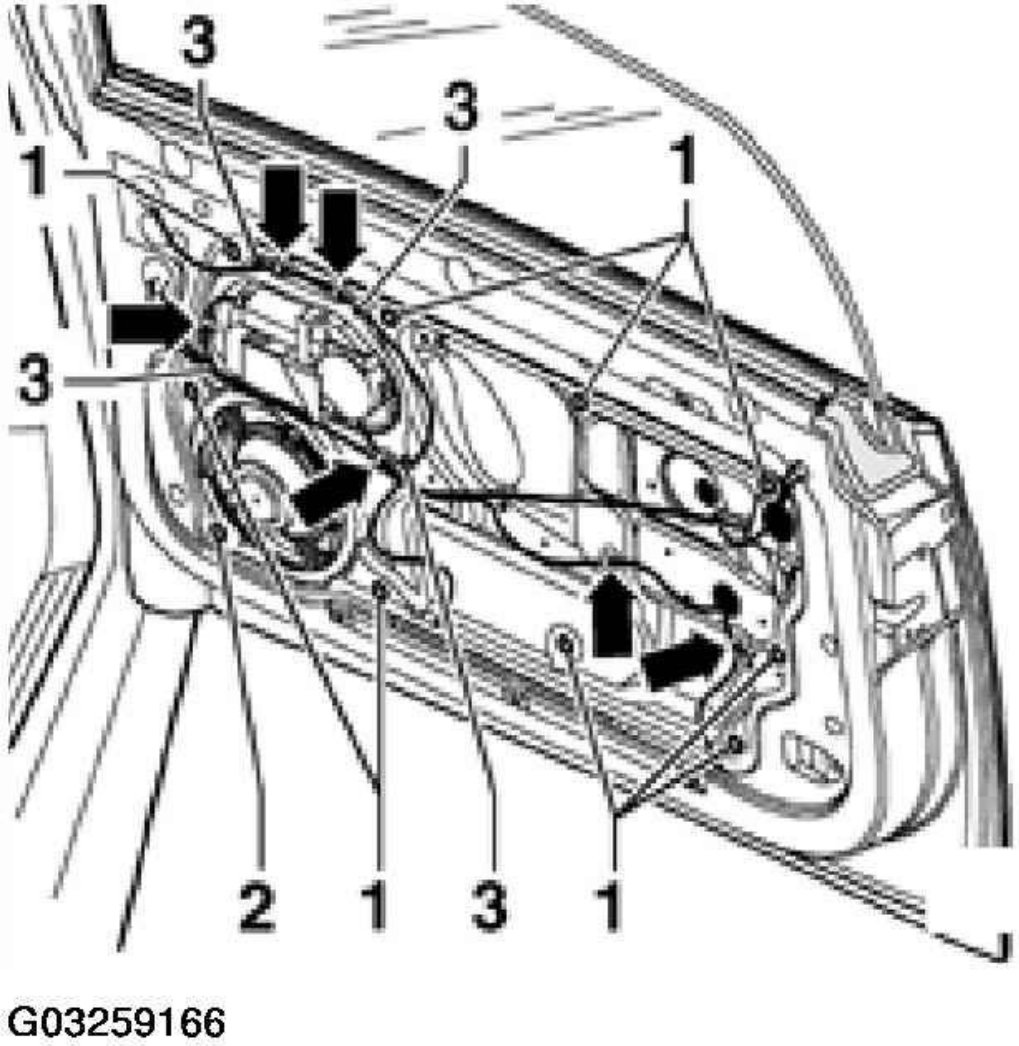

Fig. 41: Mounting Guide Sleeve Onto Crankshaft Journal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Slide oil seal over guide sleeve.
- Press seal against limit stop using press sleeve from 3266. To do this, use old center bolt for crankshaft toothed belt sprocket:

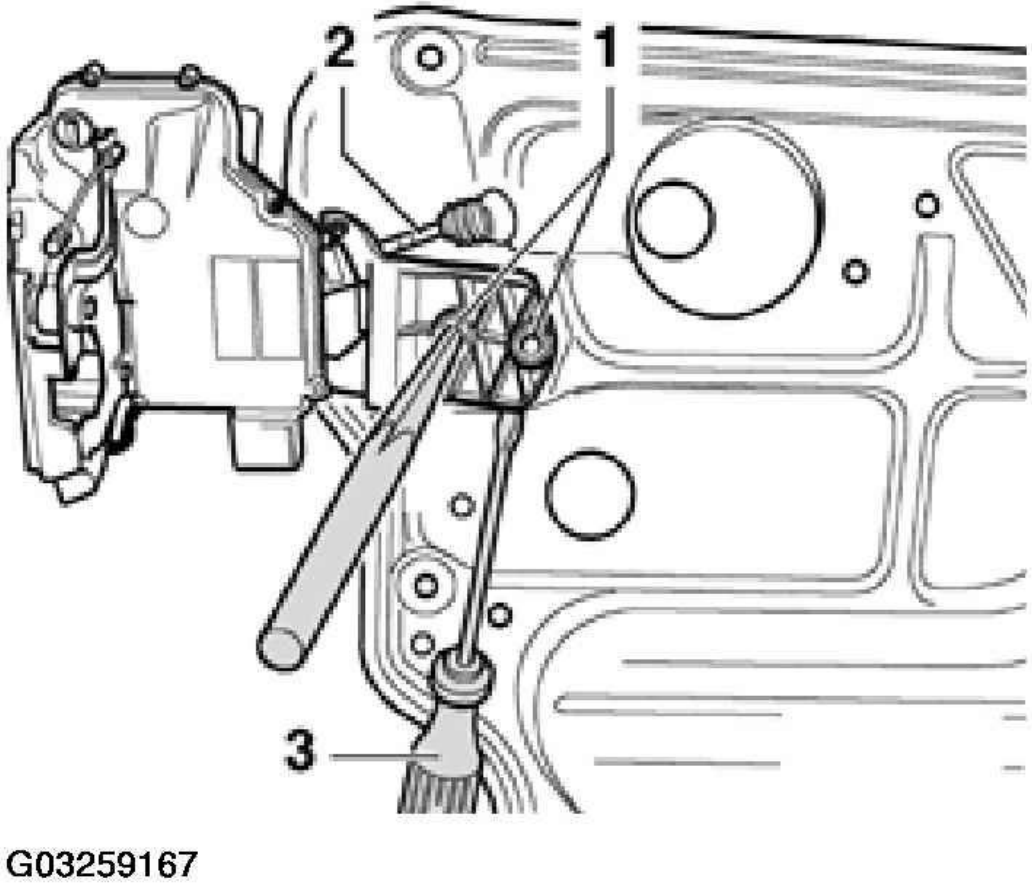

Fig. 42: Pressing Oil Seal (Coil Spring Seal)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press seal against limit stop.

Continuation for all seals

- Install crankshaft toothed belt pulley and counter support with 3415.
- Tighten new center bolt to 90 N.m plus 90° (1/4 turn) further (turning further can be done in several stages).

NOTE: Thread and shoulder must be free of oil and grease.
Installing toothed belt and adjusting timing. See TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING .

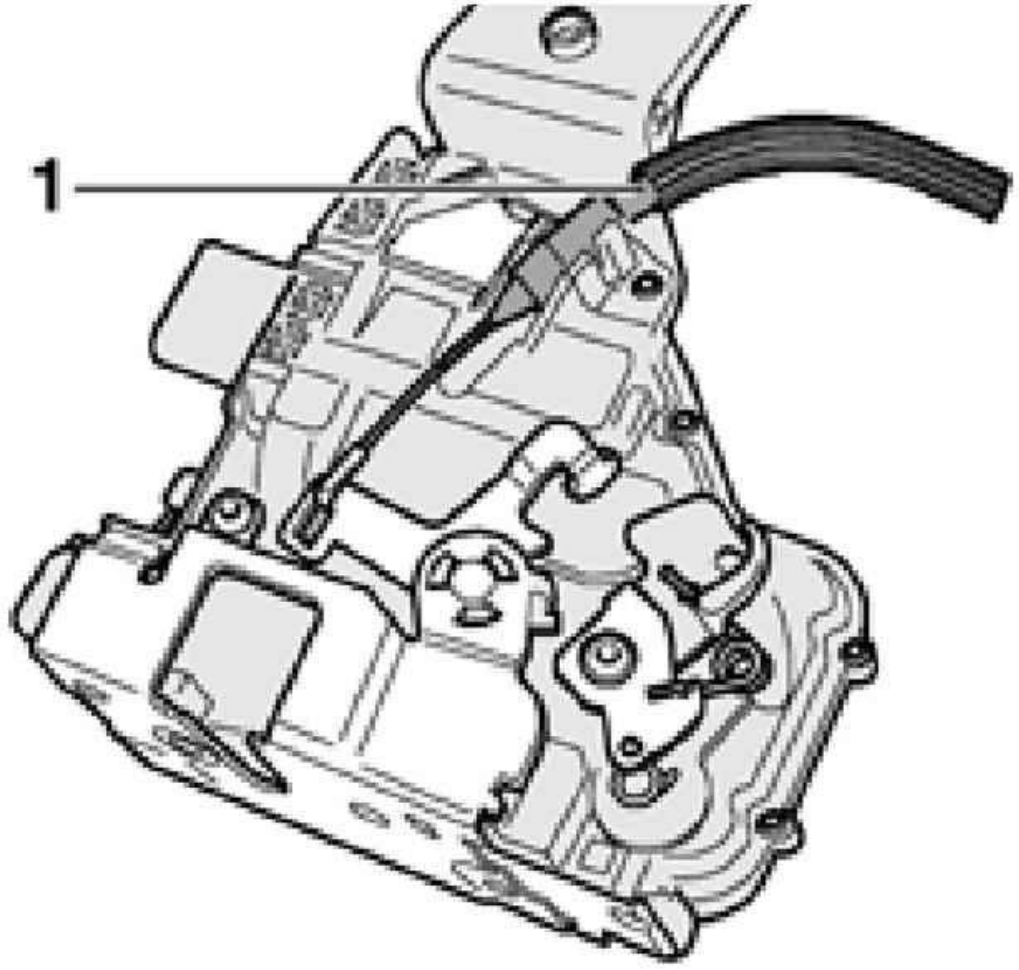

Fig. 43: Installing Crankshaft Toothed Belt Pulley And Counter Support
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .

Front sealing flange, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

For PTFE seals:

- 3415 Counter support
- T10053 Assembly device
- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)
- Hand drill with plastic brush attachment
- D 176 404 A2 Silicone sealant
- Flat scraper

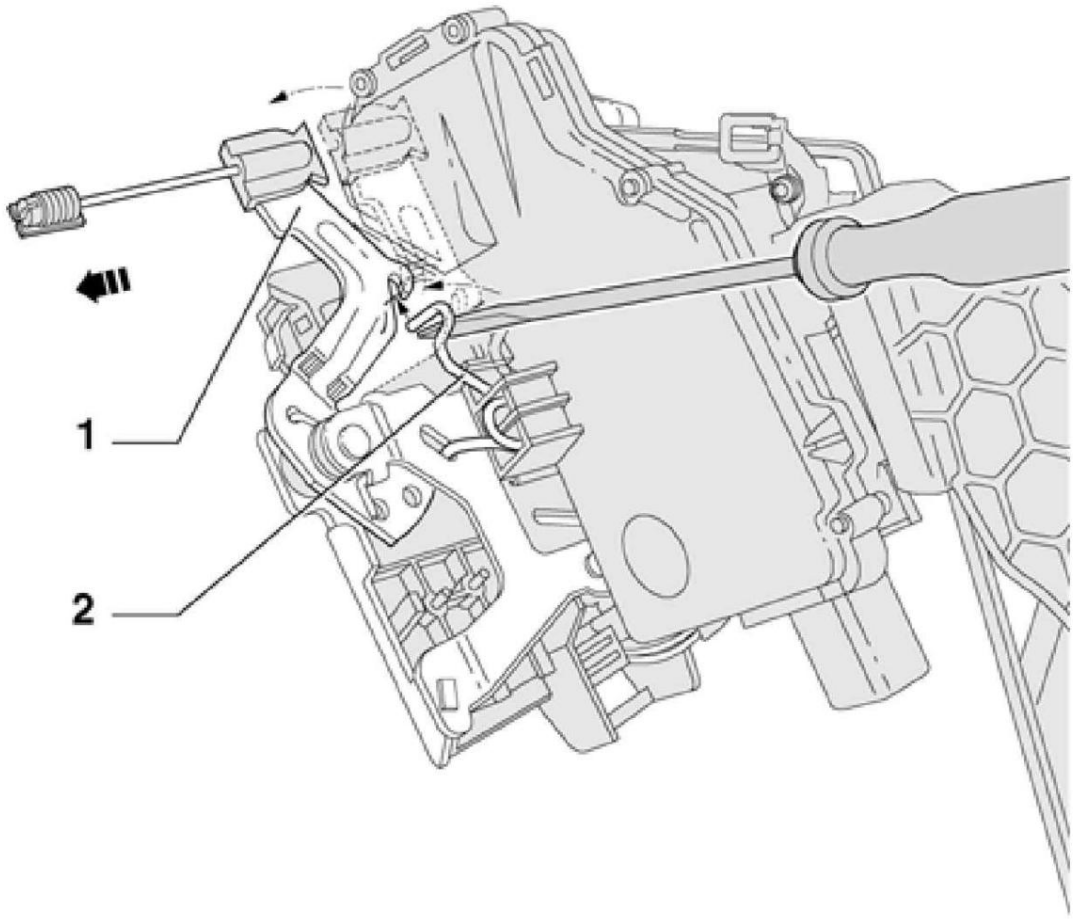

Fig. 44: Identifying Special Tools And Equipment (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

For coil spring seals:

- 2080 A Installation sleeve
- 3415 Counterhold

- V.A.G 1331 Torque wrench (5 ... 50 N.m)
- V.A.G 1332 Torque wrench (40 ... 200 N.m)
- Hand drill with plastic brush attachment
- D 176 404 A2 Silicone sealant
- Flat scraper

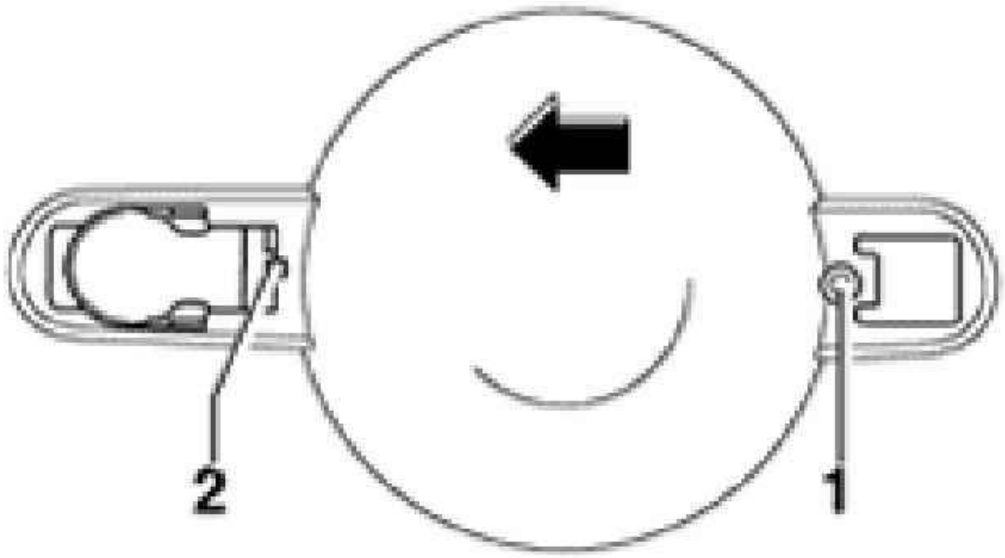

Fig. 45: Identifying Special Tools And Equipment (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.
- Remove toothed (timing) belt. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .
- Remove crankshaft toothed belt pulley. To do this counter support sprocket with 3415.

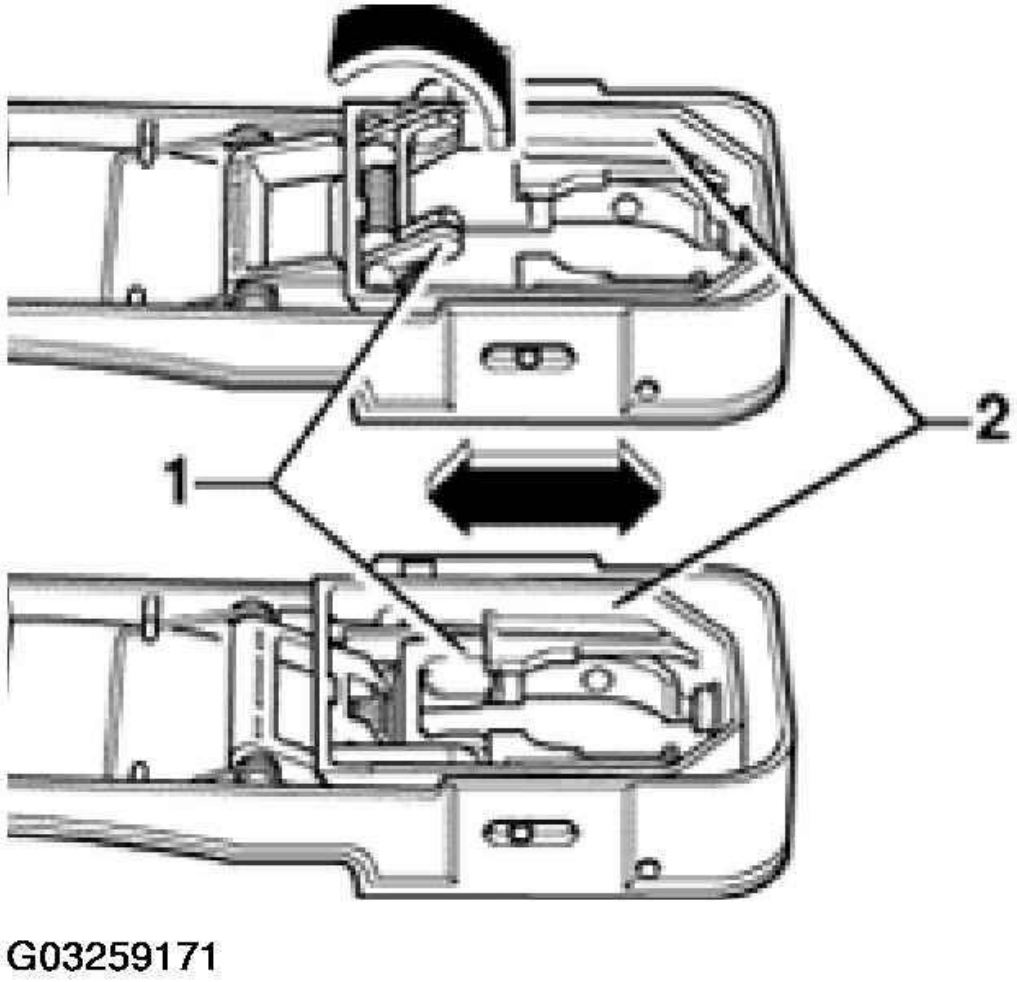

Fig. 46: Removing Crankshaft Toothed Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Drain engine oil.
- Remove oil sump. See **OIL SUMP, REMOVING AND INSTALLING** .
- Unbolt front sealing flange.
- Take off sealing flange, release using light blows with a rubber headed hammer if necessary.
- Remove sealant residue from cylinder block with a flat scraper.

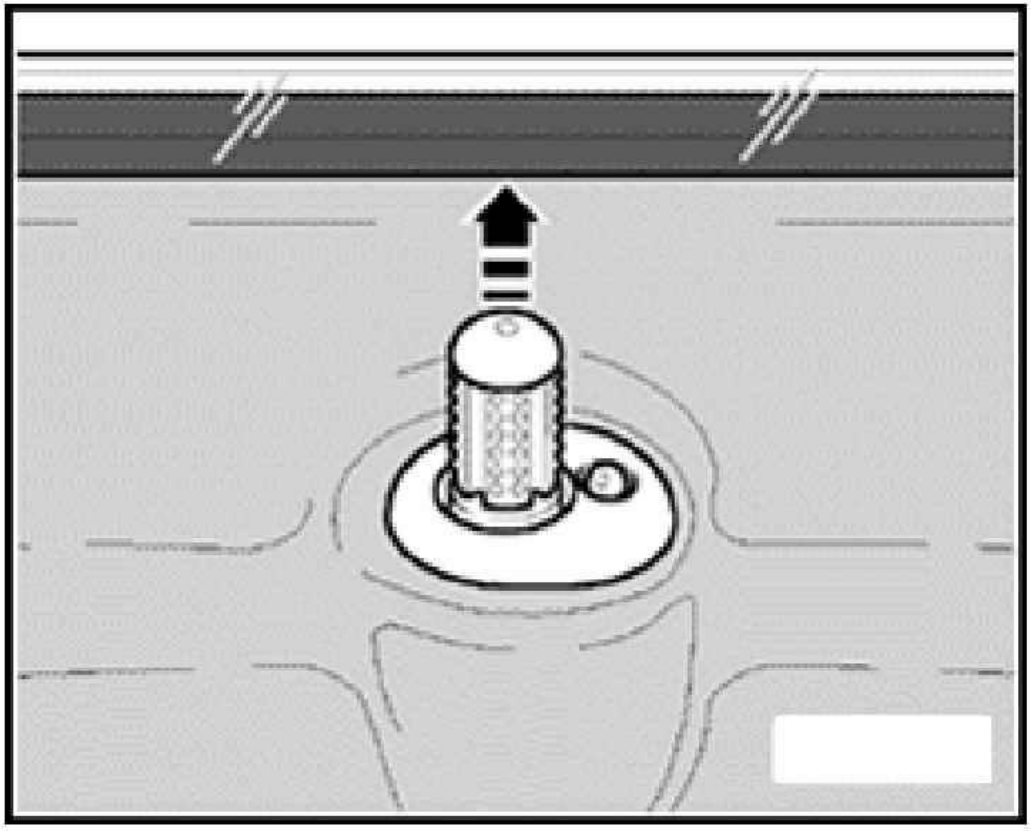

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Fig. 47: Removing Sealant Remains On Front Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Cover oil seal with a clean cloth.
- Remove sealant remains on sealing flange with a rotating plastic brush (wear protective goggles).
- Clean sealing surfaces. Surfaces must be free of oil and grease.

Installing

- Cut off tube nozzle at front marking (nozzle approx. 3 mm diameter).
- Apply silicone sealing compound, as shown, to clean sealing surface of sealing flange.
  - Thickness of sealant bead (arrows): 2 ... 3 mm

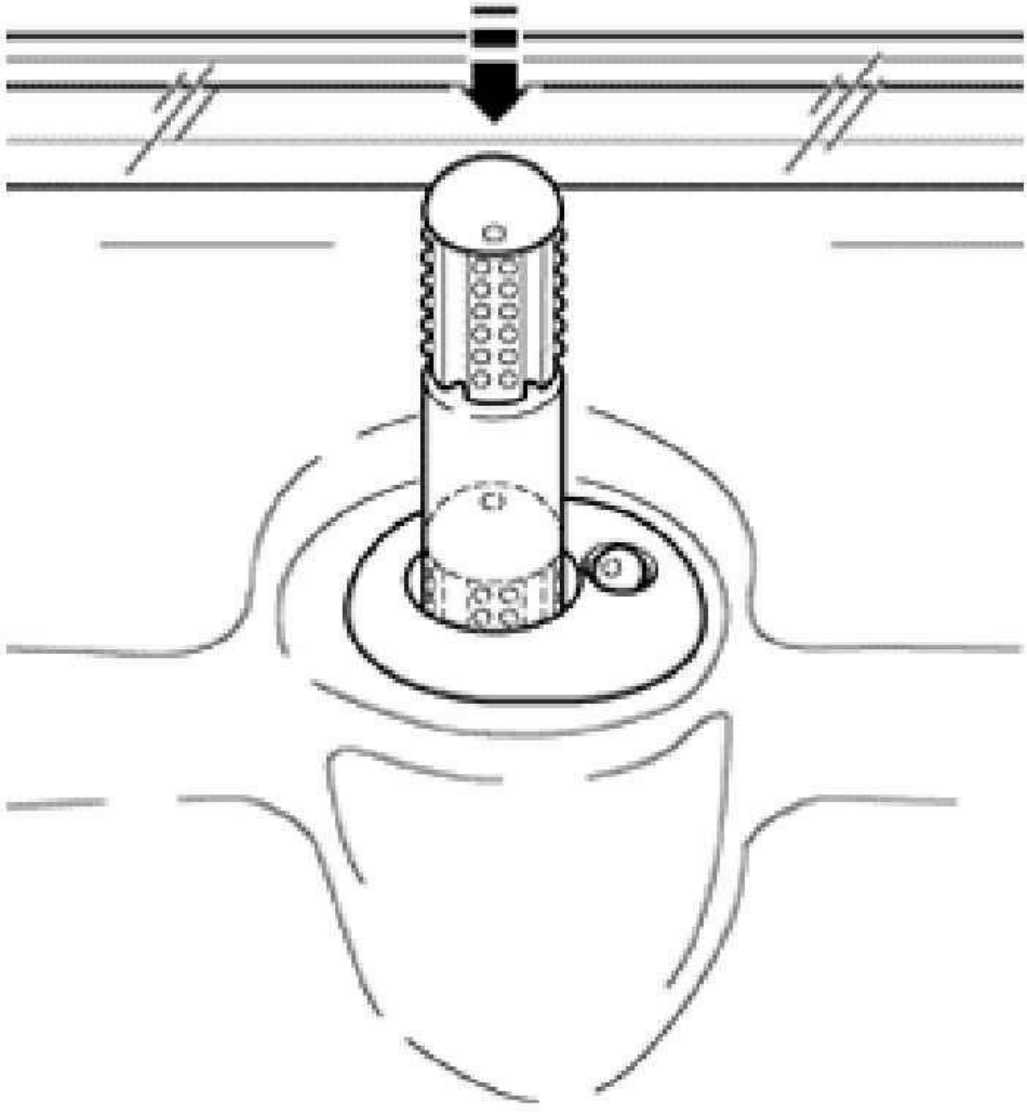

Fig. 48: Applying Silicone Sealing Compound To Sealing Surface Of Front Sealing Flange
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE:

- **Before applying sealing bead, cover the oil seal with a clean cloth.**
- **The sealing compound bead must not be thicker, otherwise excessive sealing compound will enter the sump and may block**

the oil suction pipe strainer.

- **Note the use-by date of the sealant.**
- **The sealing flange must be installed within 5 minutes of applying the silicone sealing compound.**

PTFE sealing rings

NOTE: Use guide sleeve T10053/1 to fit sealing flange with the oil seal already installed.

Coil spring seals

NOTE: Use guide sleeve 2080 A to fit sealing flange with the oil seal already installed.

Continuation for all seals

NOTE: The sealant must be allowed to cure for approx. 30 minutes after installing the sump. After this time the engine may be filled with engine oil.

- Install sealing flange immediately and lightly tighten all bolts.
- Tighten sealing flange securing bolts using an alternating sequence and torque to 15 N.m.
- Remove excess sealing compound.
- Install sump. See **OIL SUMP, REMOVING AND INSTALLING** .
- Install crankshaft toothed belt pulley and counter support with 3415. Torque bolts to 90 N.m + 1/4 turn (90°) further.

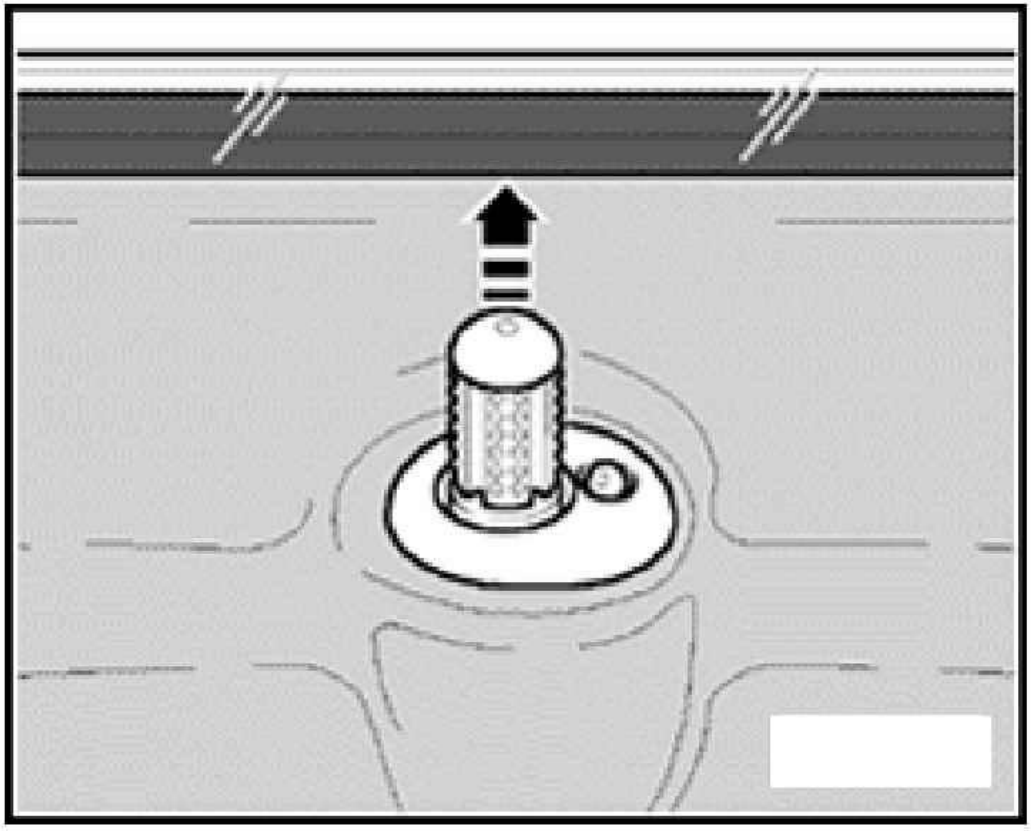

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Fig. 49: Installing Crankshaft Toothed Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Thread and shoulder must be free of oil and grease.

- Install toothed belt and adjust timing. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .
- Install tensioning element for ribbed belt.
- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .

Drive plate, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- VW 558 Counter support tool

- Hex bolt M8 x 45 and two M10 hex nuts
- Depth gauge

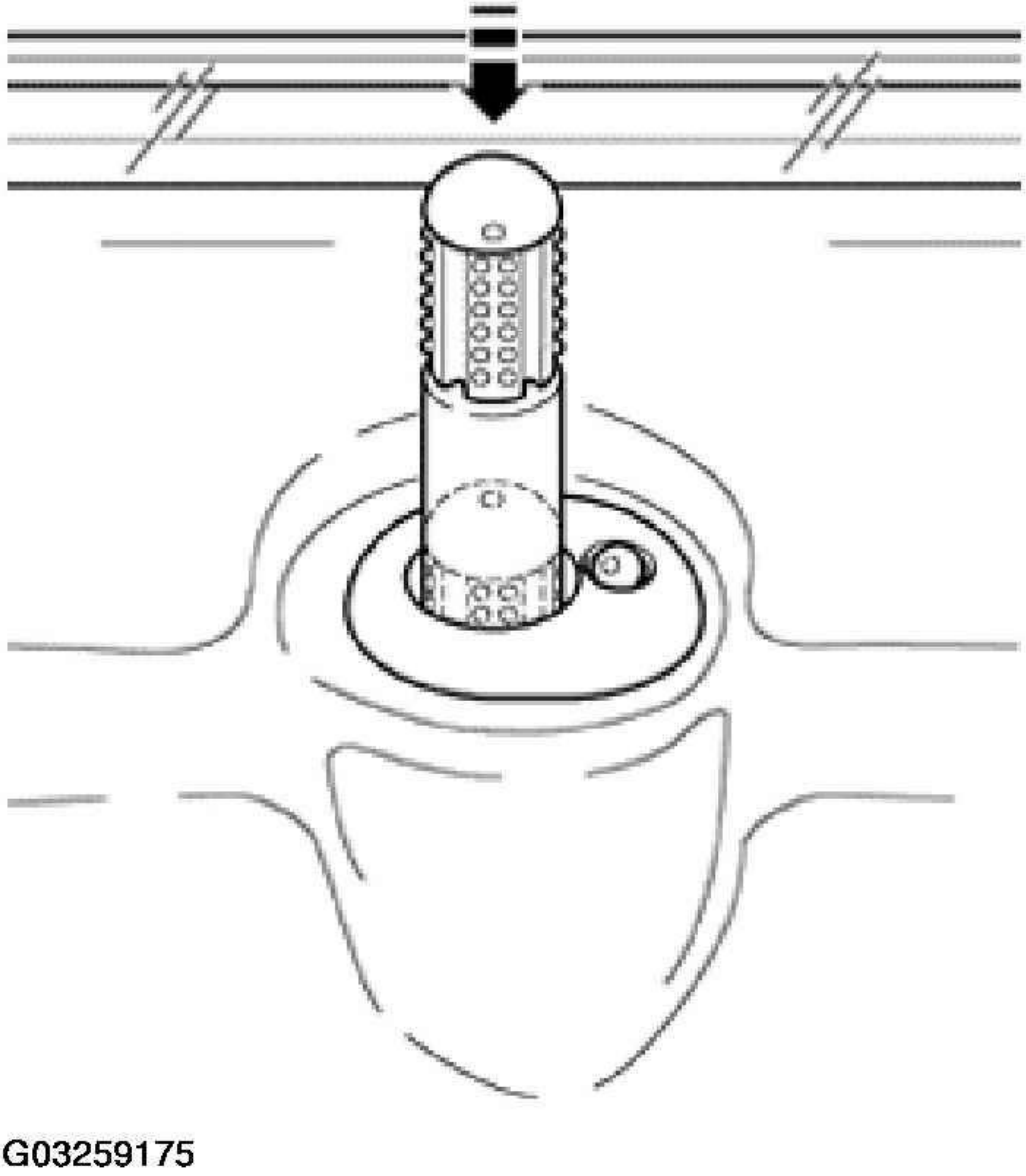
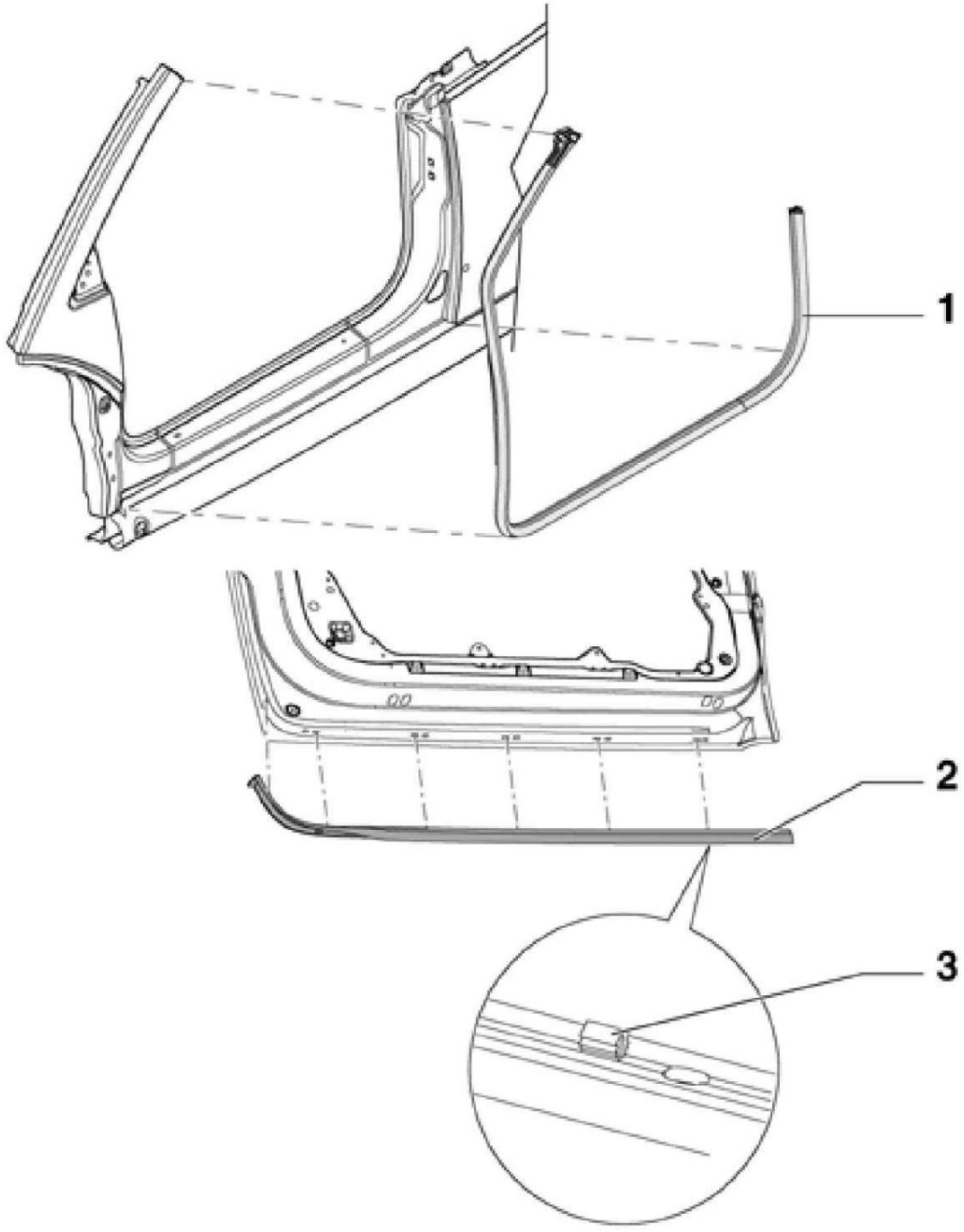


Fig. 50: Identifying Special Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Loosening and tightening drive plate

- Secure counter support tool VW 558 to the drive plate with a M8 x 45 hex bolt. Place two M10 hex nuts between counter support tool and drive plate.



1 - Door inner seal

2 - Dust seal

3 - Clip

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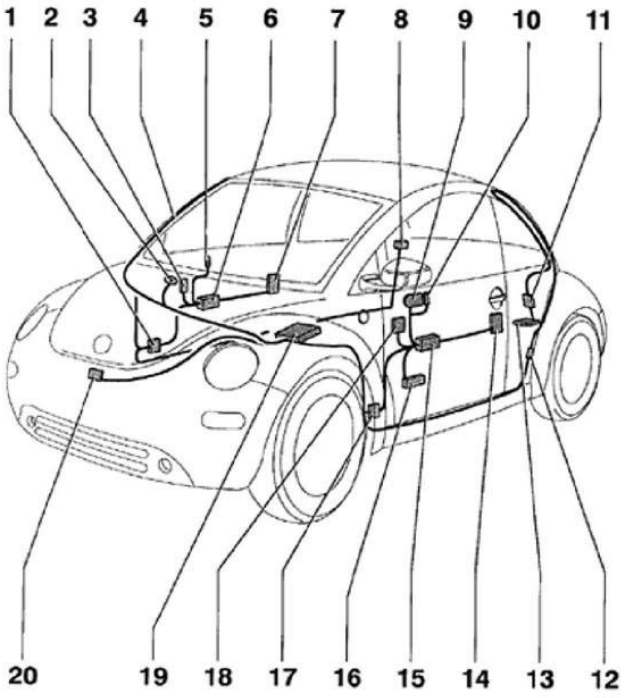
Fig. 51: Securing Counter Support Tool To Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Position of counter support tool:

A. To loosen
B. To tighten

Installing drive plate

- Locate drive plate and packing plate with recesses -1-.
- Install new bolts -3- and tighten to 30 N.m.



1 - Coupling station
2 - Anti-theft alarm horn
3 - Front right power window switch
4 - Aerial for remote control
5 - Interior locking switch, front passenger's side
6 - Front right door control unit
7 - Front right door lock
8 - Motor for fuel tank lid unlock V155
9 - Exterior mirror adjustment switch and change-over switch
10 - Interior locking switch, driver's side
11 - Tailgate/trunk lid remote release motor
12 - Coupling station
13 - Hood lock
14 - Front left door lock
15 - Front left door control unit
16 - Controls
17 - Coupling station
18 - Power window switch
19 - Central control unit
20 - Hood lock

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Fig. 52: Installing Drive Plate
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Measure dimension -a- at three different outer holes of drive plate (120° offset) and calculate average.

Specification: 19.5...21.1 mm

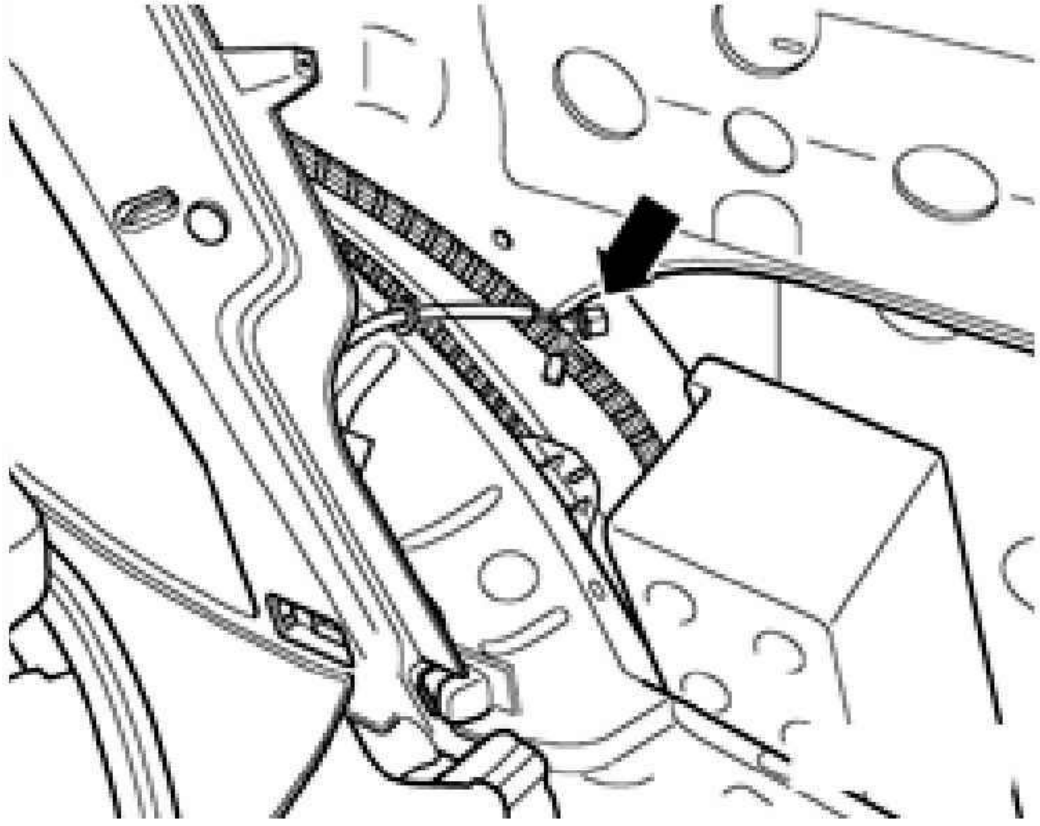

Fig. 53: Measuring Clearance Between Drive Plate And Engine Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Measure through hole in drive plate to milled surface of cylinder block. To do this unhook intermediate plate (See Fig. 32).

If the specification is not attained:

- Remove drive plate again and install shim -2-. Again tighten bolts -3- to 30 N.m.

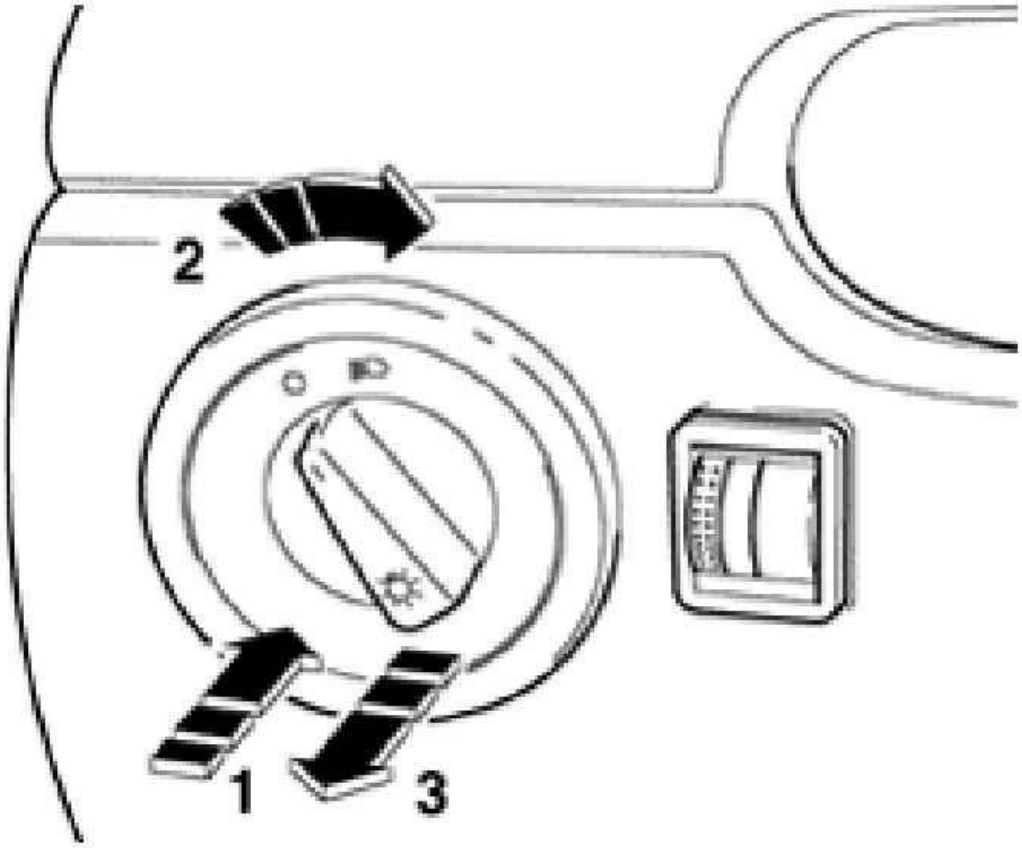

Fig. 54: Installing Drive Plate With Shim
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten bolts to 60 N.m and 90° (1/4turn) further (turning further can be done in several stages).

CRANKSHAFT, REMOVING AND INSTALLING

NOTE:

- **Before removing the crankshaft, prepare a suitable place to set it to ensure that the sensor wheel (item -8-) is free and does not get damaged.**
- **When stripping and assembling the engine it should be secured to the engine frame with engine and transmission bracket VW 540 and supplementary set VW 540/1B.**

Engine codes AEG, AVH, AZG, BEV

NOTE: The following list refers to items in Fig. 55 .

1. **Oil pump**
   - With pressure relief valve of 12 bar
   - Before installing, check that both dowel sleeves for centralizing oil pump/cylinder block are installed
   - Removing and installing. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING**
2. **15 N.m**
3. **Chain sprocket**
   - For oil pump drive
4. **Bearing shells 1,2, 3, 4 and 5**
   - Classification for ordering spare parts. See **Fig. 57**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
   - Do not interchange used bearing shells (mark)
5. **65 N.m + 90° (1/4 turn) further**
   - Replace
   - Threaded along complete length (screw)
   - Tighten to 65 N.m when measuring crankshaft radial clearance
6. **Bearing cap**
   - Bearing cap 1: Poly V-belt pulley end
   - Bearing cap 3 with recesses for thrust washers
   - Bearing shell retaining lugs (cylinder block/bearing cap) must be on same side
7. **Bearing shell 3**
   - See item - 4 -
   - Do not interchange used bearing shells (mark)
8. **Sensor wheel**
   - Replace
   - For Engine speed (RPM) sensor -G28-
   - Can only be installed in one position. Holes are offset
9. **10 N.m + 1/4 turn (90°) further**
   - Replace
10. **Thrust washer**
    - For bearing 3 bearing cap
    - Production version (1-part), upper thrust washers discontinued, item -12-
    - Observe method of securing
    - Lettering faces mounting bracket

11. **Crankshaft**
    - Axial clearance, new: 0.07 ... 0.23 mm; Wear limit: 0.30 mm
    - Check radial clearance with Plastigage, new: 0.01 ... 0.04 mm; Wear limit: 0.15 mm
    - Do not rotate crankshaft when checking radial clearance
    - Crankshaft dimensions. See **CRANKSHAFT DIMENSIONS**
12. **Thrust washer**
    - For cylinder block, bearing 3
    - Spare part version (2-part), lower thrust washers are only semicircular
    - Lettering faces mounting bracket

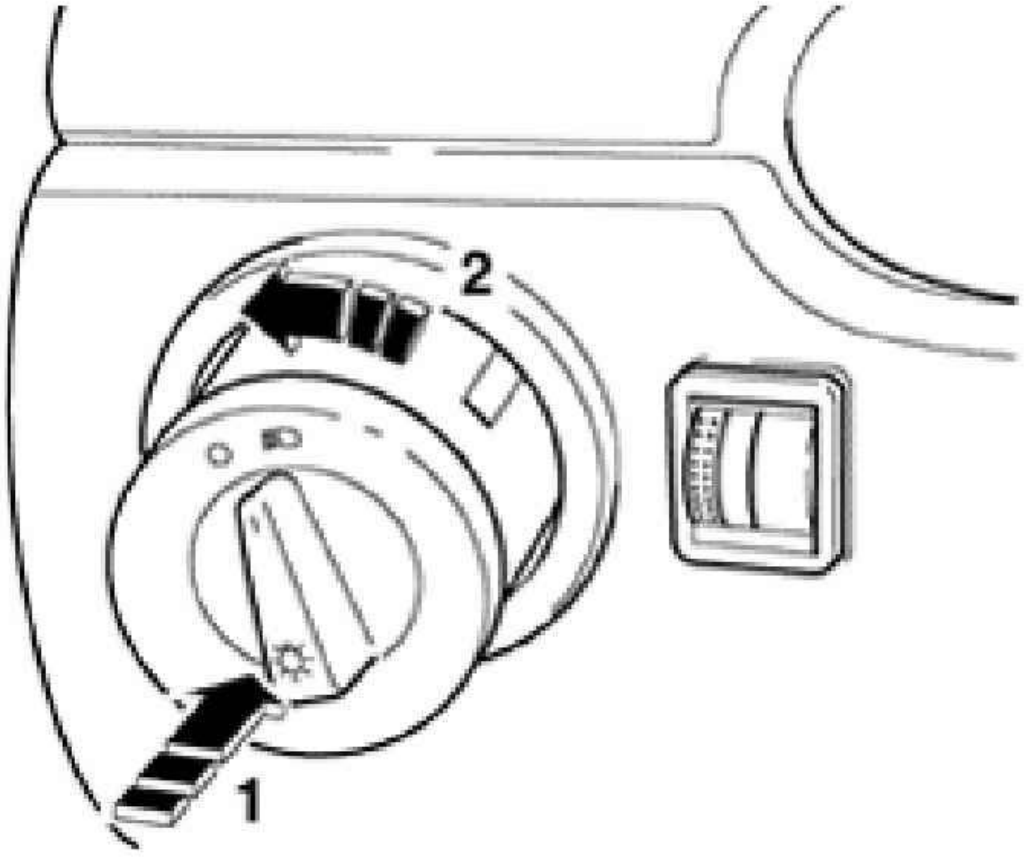

Fig. 55: Exploded View Of Crankshaft Assembly (Engine Codes AEG, AVH, AZG, BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The balancer shaft gear assembly must be adjusted. See OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING .

NOTE: The following list refers to items in Fig. 56 .

1. **Chain sprocket**
2. **Bearing shells 1,2, 3, 4 and 5**
   - Classification for ordering spare parts. See **Fig. 57**
   - For bearing cap without oil groove
   - For cylinder block with oil groove
   - Do not interchange used bearing shells (mark)
3. **65 N.m + 90° (1/4 turn) further**
   - Replace
   - Threaded along complete length (screw)
   - Tighten to 65 N.m when measuring crankshaft radial clearance
4. **Bearing cap**
   - Bearing cap 1: Ribbed belt pulley end
   - Bearing cap 3 with recesses for thrust washers
   - Bearing shell retaining lugs (cylinder block/bearing cap) must be on same side
5. **Bearing shell 3**
   - See Step 2
   - Do not interchange used bearing shells (mark)
6. **Sensor wheel**
   - Replace
   - For Engine speed (RPM) sensor -G28-
   - Can only be installed in one position. Holes are offset
7. **10 N.m + 1/4 turn (90°) further**
   - Replace
8. **Thrust washer**
   - For bearing 3 bearing cap
   - Observe adjustment
   - Lettering faces mounting bracket
9. **Crankshaft**
   - Axial clearance, new: 0.07...0.23 mm; Wear limit: 0.30 mm
   - Check radial clearance with Plastigage, new: 0.01...0.04 mm, Wear limit: 0.07 mm
   - Do not rotate crankshaft when checking radial clearance

- Crankshaft dimensions. See **CRANKSHAFT DIMENSIONS**

10. **Thrust washer**
    - For cylinder block, bearing 3
    - Lettering faces mounting bracket

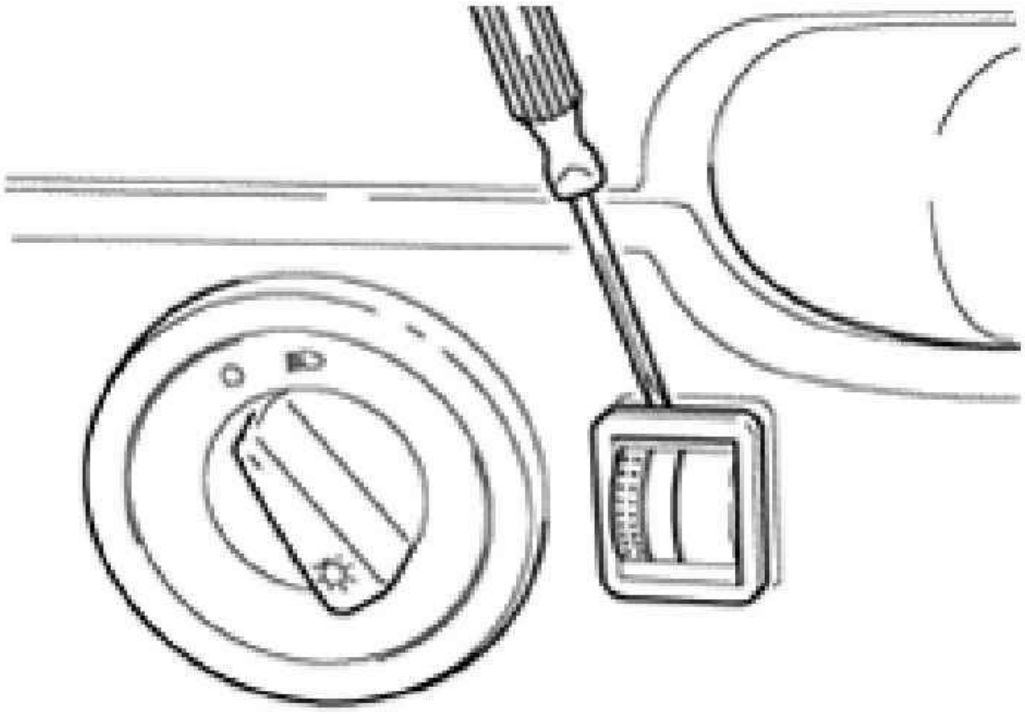

Fig. 56: Exploded View Of Crankshaft Assembly (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Upper crankshaft bearing identification (gradual introduction)

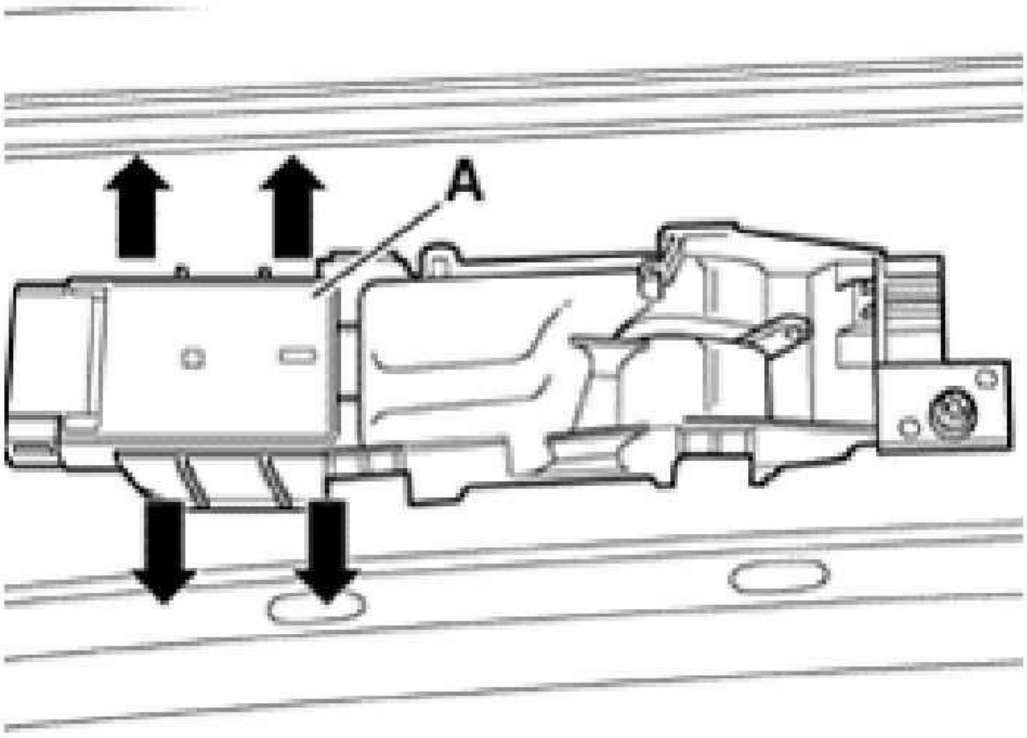

Fig. 57: Locating Upper Crankshaft Bearing Identification Marks
Courtesy of VOLKSWAGEN OF AMERICA, INC.

In the factory the upper bearing caps are allocated with the correct thickness for the cylinder block. Colored marks are used to identify the thickness of the bearing shells. See **CRANKSHAFT BEARING COLOR MARKINGS** .

Which thickness of shell should be installed to which location is marked by a letter on the lower sealing surface of the cylinder block -x-.

Arrow indicates direction of travel (forward).

Crankshaft bearing color markings

CRANKSHAFT BEARING COLOR MARKINGS SPECIFICATIONS

Letter on cylinder block	Color of bearing
S =	Black
R =	Red

G =	Yellow

NOTE:

- **If the colored marks have not been stamped or are no longer legible, use the average bearing shell (red).**
- **The lower crankshaft bearing shells are always supplied as a spare part with the color marking "yellow".**

Crankshaft dimensions

Dimensions in mm.

CRANKSHAFT DIMENSIONS SPECIFICATIONS

Grinding dimension(1)	Crankshaft bearing journal diameter	Connecting rod journal diameter
Basic dimension	-0.017 54.00 -0.037	-0.022 47.80 -0.042
1st undersize	-0.017 53.75 -0.037	-0.022 47.55 -0.042
2nd undersize	-0.017 53.50 -0.037	-0.022 47.30 -0.042
3rd undersize	-0.017 53.25 -0.037	-0.022 47.05 -0.042
(1) All dimensions are in mm.		

PISTON AND CONNECTING ROD, DISASSEMBLING AND ASSEMBLING

Gradual introduction of "industrially fractured" connecting rods.

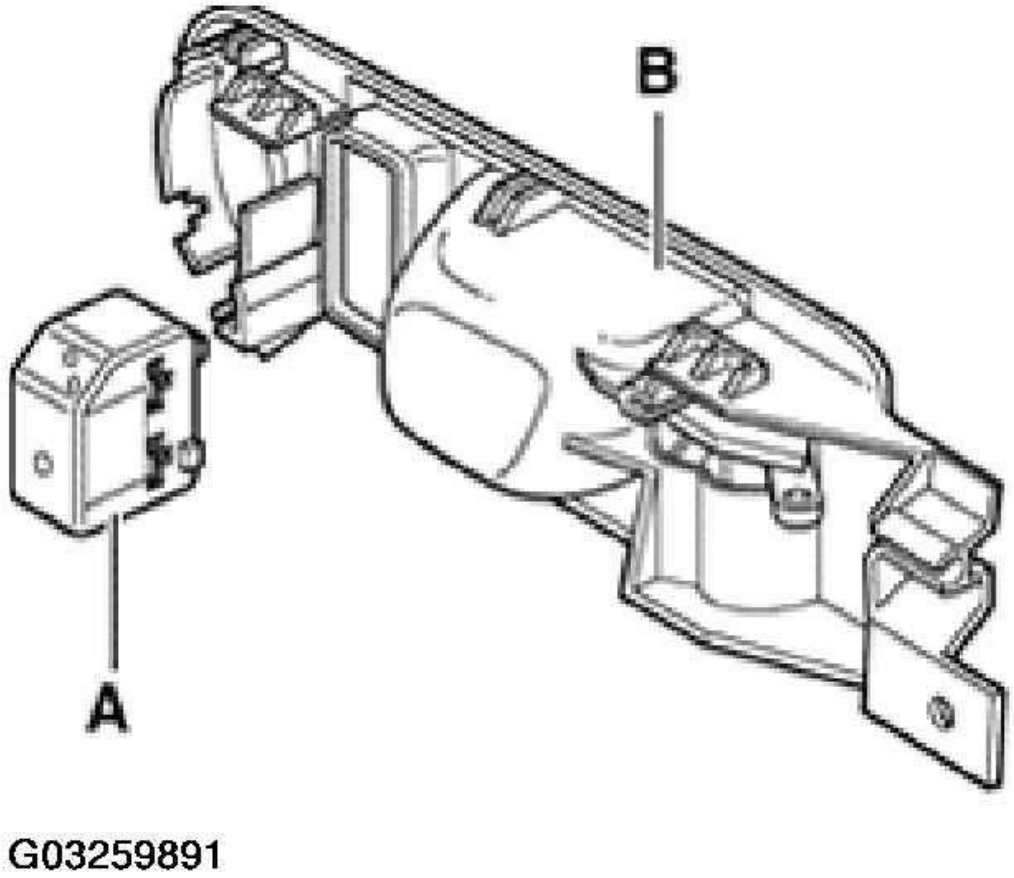

Fig. 58: Identifying "Industrially Fractured" Connecting Rods
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Distinguishing features:

A. Older type connecting rods (smooth joint along contact surface)
B. Industrially fractured connecting rods (rough joint along contact surface)

- Disassembling and assembling piston and older type connecting rod. See **OLDER TYPE CONNECTING RODS**
- Disassembling and assembling piston and industrially fractured connecting rod. See **INDUSTRIALLY FRACTURED CONNECTING RODS**

Older type connecting rods

NOTE: The following list refers to items in Fig. 59 .

1. **Piston rings**
   - Offset gaps by 120°
   - Use piston ring pliers to remove and install
   - "TOP" faces piston crown
   - Checking ring gap. See **Fig. 61**
   - 2-part oil scraper ring
2. **Piston**
   - Checking. See **Fig. 63**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to belt pulley end
   - Checking ring to groove clearance. See **Fig. 62**
   - Install using piston ring clamp
3. **Connecting rod**
   - Only replace as a set
   - Mark allocation to cylinder -B-
   - Installation position: Marking -A- faces belt pulley end
4. **Connecting rod bearing cap**
   - Mark allocation to cylinder -B-
   - Installation position: Marking -A- faces belt pulley end
5. **30 N.m + 1/4 turn (90°) further**
   - Replace
   - Oil thread and contact surface
   - To measure radial clearance tighten to 30 N.m, but do not turn further
6. **Bearing shell**
   - Observe installing position
   - Do not interchange used bearing shells
   - Ensure retaining lugs fit tightly in recesses
   - Upper bearing shell with oil drilling for piston pin lubrication
   - Axial clearance, new: 0.05 ... 0.31 mm; Wear limit: 0.37 mm
   - Check radial clearance with Plastigage, new: 0.01 ... 0.06 mm; Wear limit: 0.12 mm
   - Do not rotate crankshaft when checking radial clearance
7. **Cylinder block**
   - Checking cylinder bore. See **Fig. 65**
   - Piston and cylinder dimensions. See **PISTON AND CYLINDER DIMENSIONS**
8. **Connecting rod bolt**

9. **Circlip**
10. **Piston pin**
    - If difficult to remove, heat piston to 60° C
    - Remove and install with VW 222a

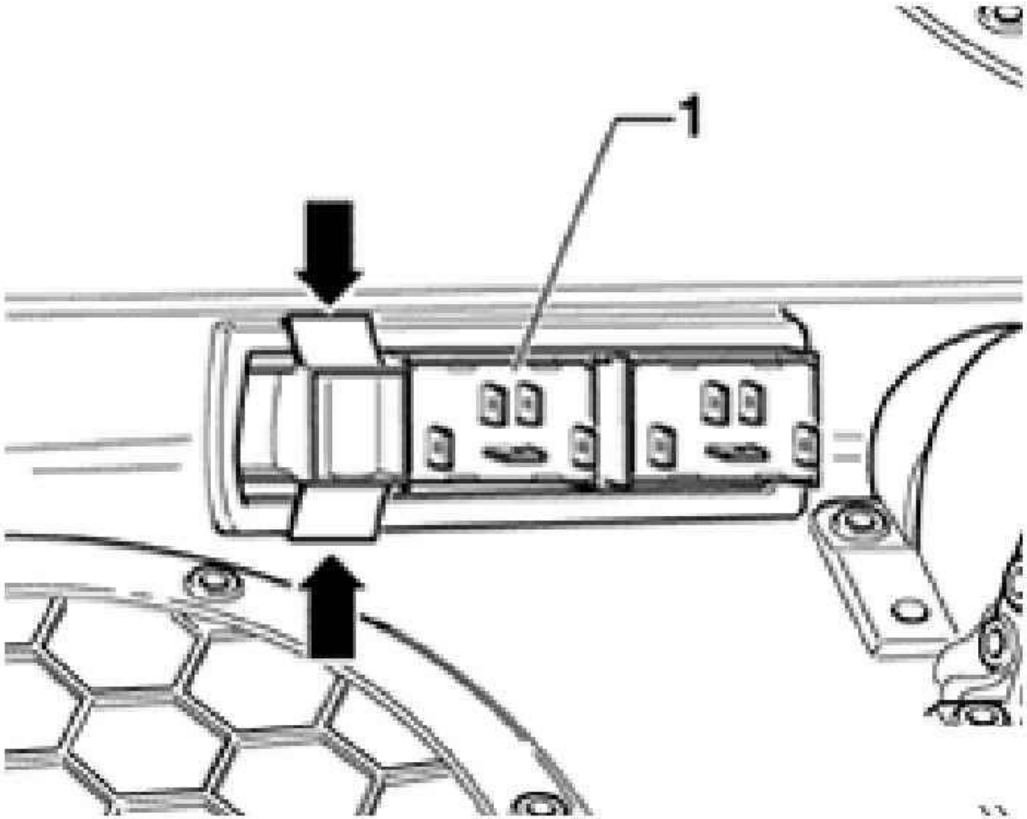

Fig. 59: Exploded View Of Piston And Connecting Rod Assembly (Older Type Connecting Rods)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Industrially fractured connecting rods

NOTE: The following list refers to items in Fig. 60 .

1. **Piston rings**
    - Offset gaps by 120°

- Use piston ring pliers to remove and install
- "TOP" faces piston crown
- Checking ring gap. See **Fig. 61**
- Checking ring to groove clearance. See **Fig. 62**
- Oil scraper ring 2- or 3-part

2. **Piston**
   - Checking. See **Fig. 63**
   - Mark installation position and cylinder number
   - Arrow on piston crown points to pulley end
   - Install using piston ring clamp
3. **Floating piston pin**
   - If difficult to remove, heat piston to 60 °C
   - Remove and install with VW 222A
4. **Snap ring**
5. **Connecting rod**
   - With cracked bearing cap
   - Only replace as a set
   - Mark relationship to cylinder -B-
   - Installation position: Marking -A- faces belt pulley end
6. **Bearing shell**
   - Observe installation position. See **Fig. 64** .
   - Insert bearing shells centrally
   - Do not interchange used bearing shells
   - Check if seated securely
   - Axial clearance, new: 0.10...0.35 mm; Wear limit: 0.4 mm
   - Check radial clearance with Plastigage, new: 0.01...0.05 mm; Wear limit: 0.09 mm
   - Do not rotate crankshaft when checking radial clearance
7. **Cylinder block**
   - Checking cylinder bore. See **Fig. 65**
   - Piston and cylinder dimensions. See **PISTON AND CYLINDER DIMENSIONS**
8. **Connecting rod bearing cap**
   - Observe installing position
   - Caps only fit in one position and only on appropriate connecting rod due to breaking procedure (industrially fracturing) separating cap from connecting rod
9. **30 N.m + 1/4 turn (90°) further**
   - Torx E 10
   - Replace

- Oil thread and contact surface
- To measure radial clearance tighten to 30 N.m, but do not turn further

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Fig. 60: Exploded View Of Piston And Connecting Rod Assembly (Industrially Fractured Connecting Rods)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Piston Ring Gap

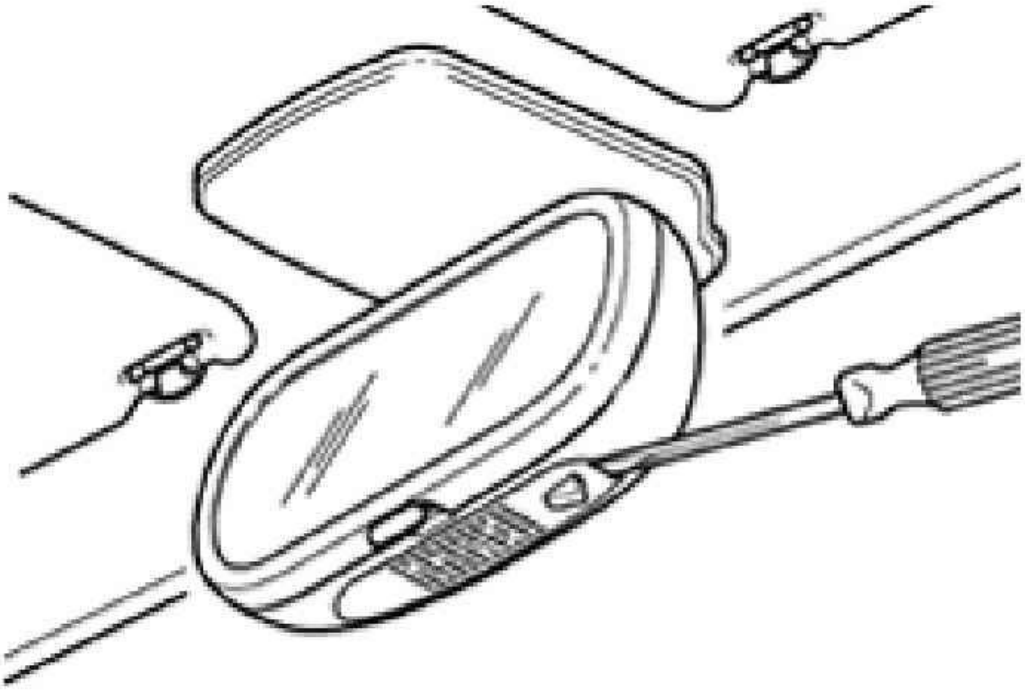


Fig. 61: Checking Piston Ring End Gap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools, testers, measuring instruments and auxiliary items required

- Feeler gauge

Work sequence

- Push ring squarely from above down to approx. 15 mm from bottom end of cylinder.

PISTON RING END GAP SPECIFICATIONS

Piston Ring	New	Wear limit
Compression mm rings	0.20...0.40	0.8
Oil scraper ring mm	0.25...0.50	0.8

Checking Ring To Groove Clearance

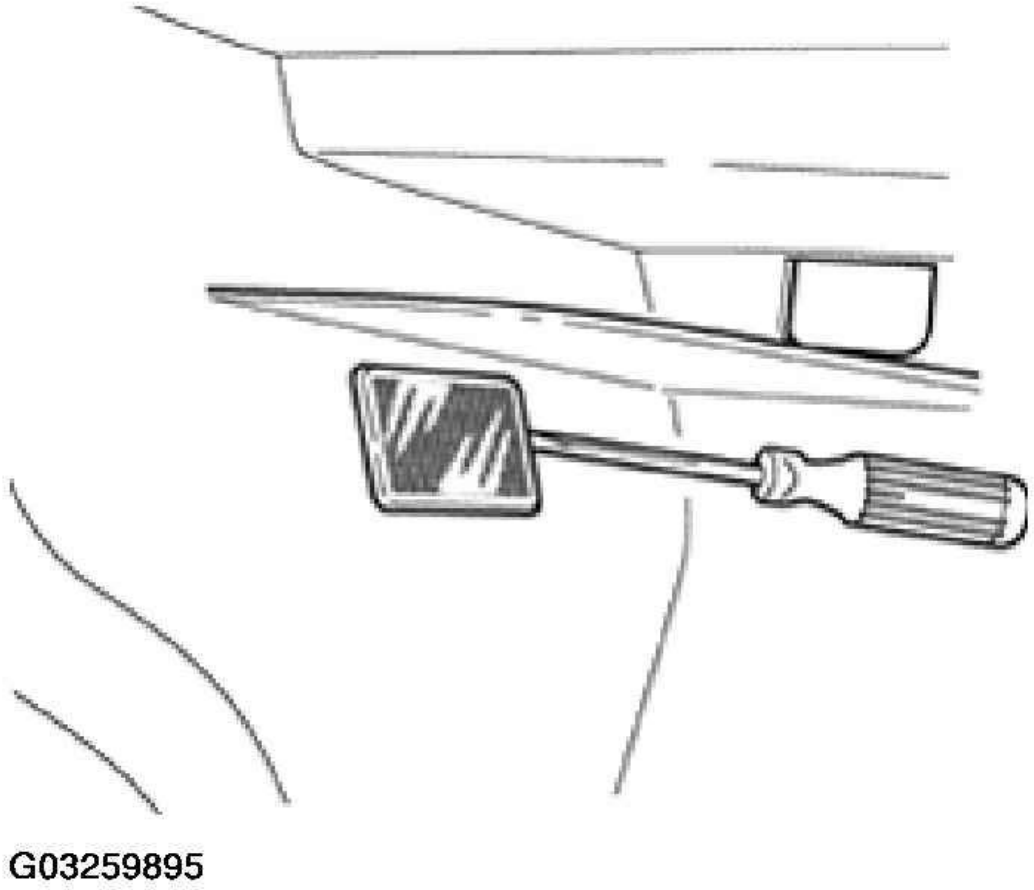


Fig. 62: Checking Ring To Groove Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools, testers, measuring instruments and auxiliary items required

- Feeler gauge

Work sequence

Clean groove before checking.

PISTON RING TO GROOVE CLEARANCE SPECIFICATIONS

Piston Ring	New	Wear limit
Compression rings mm	0.06...0.09	0.20
Oil scraper ring	0.03...0.06	0.15

mm		

Measuring Piston Lower Edge Of Skirt

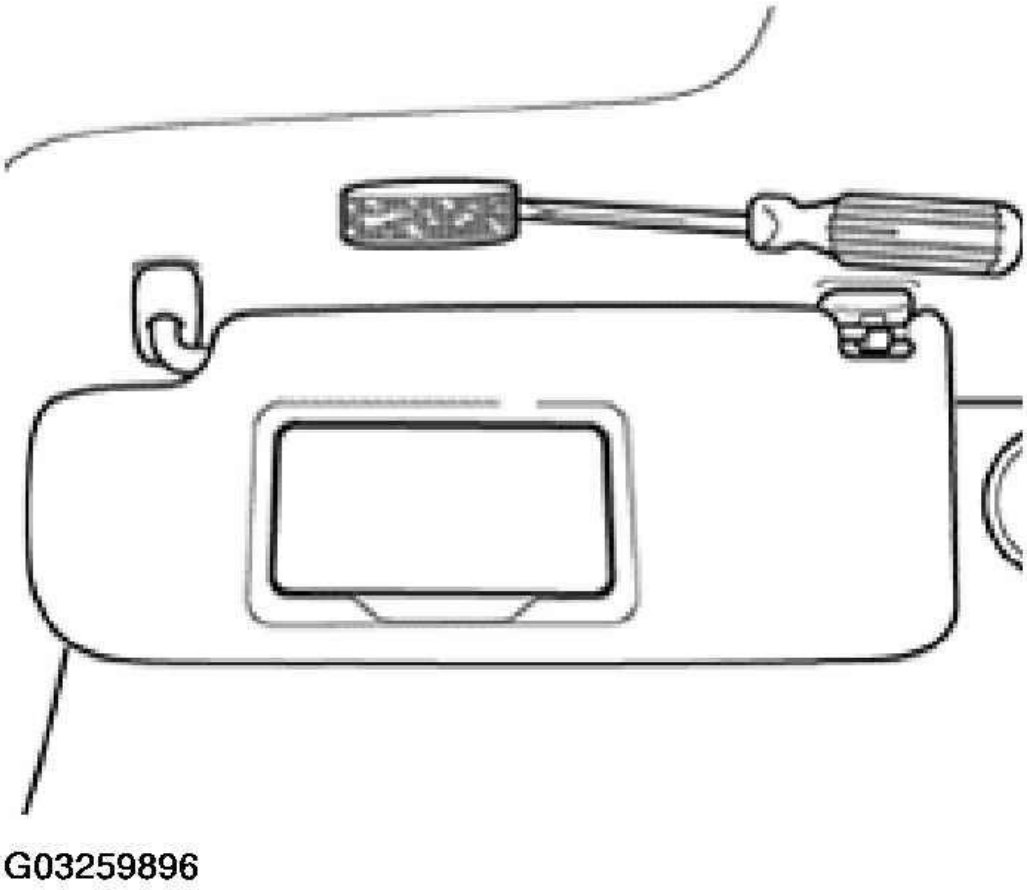


Fig. 63: Measuring Piston Lower Edge Of Skirt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools, testers, measuring instruments and auxiliary items required

- External micrometer 75...100 mm

Work sequence

- Measure pistons approx. 10 mm from the lower edge of skirt, 90° offset to axis of floating piston pin.

  Deviation from nominal dimension: max. 0.04 mm

Installation Position Of Bearing Shells

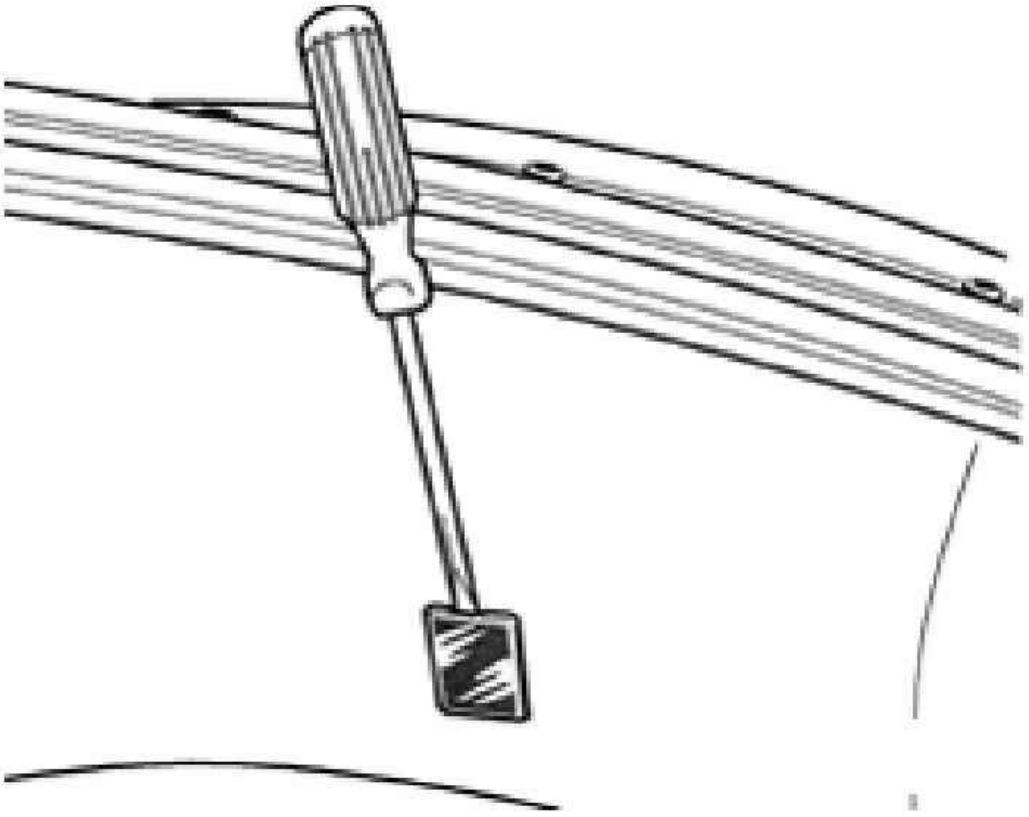


Fig. 64: Identifying Installation Position Of Connecting Rod Bearing Shells
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Bearing shell -1- with oil channel (arrow) for connecting rod

Bearing shell -2- without oil channel connecting rod bearing cap

- Insert bearing shells and connecting rod bearing cap centrally.

  Dimension -a- must be same on both left and right side, maximum deviation 0.2 mm

Checking Cylinder Bores

Fig. 65: Checking Cylinder Bores
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with adapter bracket VW 540, as incorrect measurements would then be possible.

Special tools, testers, measuring instruments and auxiliary items required

- Internal dial gauge 50...100 mm
- Measure bores at 3 locations in both directions -A- across engine and -B- in line with crankshaft.

  Deviation from nominal dimension: max. 0.08 mm

Piston and cylinder dimensions

PISTON AND CYLINDER DIMENSIONS SPECIFICATIONS

Honing dimension	Piston diameter	Cylinder bore diameter
Basic dimension mm	82.465(1)	82.51
1st oversize mm	82.965(1)	83.01
(1) Dimensions without graphite coating (thickness 0.02 mm). Graphite coating wears away		

ENGINE - CYLINDER HEAD, VALVETRAIN

CYLINDER HEAD, REMOVING AND INSTALLING CYLINDER HEAD

Checking compression. See **Compression pressures, checking** .

NOTE:

- **When installing an exchange cylinder head with fitted camshaft, lubricate the running contact surfaces between the bucket tappets and the camshaft cam surfaces before installing the cylinder head cover.**
- **The plastic packing pieces for protecting the open valves must not be removed until immediately before installing the cylinder head.**
- **If the cylinder head is replaced, all the coolant in the system must also be replaced.**
- **Removing and installing intake manifold. See INTAKE MANIFOLD UPPER PART, DISASSEMBLING AND .**

Engines with steel cylinder head cover:

- Engine code AEG. See **ENGINES WITH STEEL CYLINDER HEAD COVER**

  Engines with aluminum cylinder head cover.

- Engine codes AVH, AZG, BDC, BEV, BGD. See **ENGINES WITH ALUMINUM CYLINDER HEAD COVER**

Engines with steel cylinder head cover

NOTE: The following list refers to items in Fig. 66 .

1. **Cover**
2. **Seal**
3. **Breather housing**
   - Turn to right to remove
4. **10 N.m**
5. **Seal**
   - Replace if damaged
6. **Retainer**
7. **Sealing plug, 15 N.m**
   - Replace
8. **Seal**
   - Replace
9. **Union**
   - Coolant hose connection diagram. See **COOLANT HOSE CONNECTION DIAGRAM**
10. **Lifting eye**
11. **20 N.m**
12. **Cylinder head gasket**
    - Replace
    - After replacement replace entire coolant amount
13. **15 N.m**
14. **Rear toothed belt guard**
15. **Cylinder head**
    - Check for distortion. See **Fig. 68**
    - Reworking sealing surface. See **Fig. 68**
    - Removing and installing. See **CYLINDER HEAD, REMOVING AND INSTALLING**
    - After replacement replace entire coolant amount
16. **Cylinder head bolt**
    - Replace
    - Remove and install Polydrive cylinder head bolt with 3452
    - Sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING**
17. **Oil deflector**
18. **Cylinder head cover gasket**
    - Replace if damaged
    - Coat cylinder head/bearing cap transition points with D 454 300 A2 before installing
19. **Cylinder head cover**

20. **Reinforcing strip**
21. **Rear toothed belt guard, upper part**

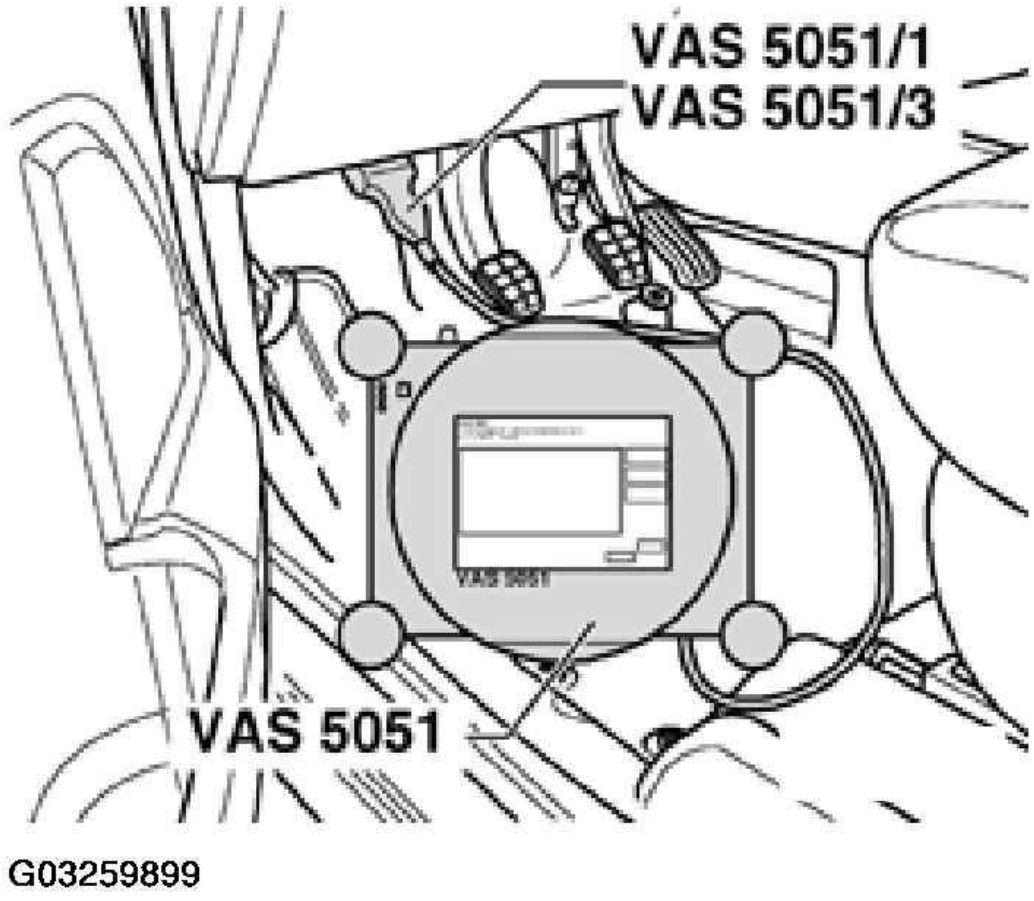


Fig. 66: Exploded View Of Cylinder Head Cylinder Head (Steel Cylinder Head Cover)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engines with aluminum cylinder head cover

NOTE: The following list refers to items in Fig. 67 .

1. **Cover**
2. **Seal**
3. **10 N.m**
4. **To intake manifold**

- Only engine codes BDC, BGD to Positive Crankcase Ventilation (PCV) heating element -N79-

5. **Shaped hose**
   - Engine codes AVH, AZG through Model Year 2001
6. **Shaped hose**
   - Engine codes AVH, AZG from Model Year 2002
   - Engine codes BDC, BEV and BGD
   - Do not remove union between intake manifold hose and shaped hose.
7. **To intake manifold upper part**
   - Only Model Year from 2002
8. **Seal**
   - Replace
9. **Sealing plug, 15 N.m**
   - Replace
10. **Cylinder head bolt**
    - Replace
    - Remove and install Polydrive cylinder head bolt with 3452
    - Sequence when loosening and tightening. See **CYLINDER HEAD, REMOVING AND INSTALLING**
11. **Connecting unions**
    - Coolant hose connection diagram. See **COOLANT HOSE CONNECTION DIAGRAM**
12. **10 N.m**
13. **Seal**
    - Replace
14. **20 N.m**
15. **Lifting eye**
16. **Cylinder head gasket**
    - Replace
    - After replacement replace entire coolant amount
17. **15 N.m**
18. **20 N.m**
19. **Rear toothed belt guard**
20. **Toothed belt**
    - Mark direction of rotation before removing
    - Check for wear
    - Do not kink
    - Removing, installing and tensioning. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING**
21. **Cylinder head**

- Check for distortion. See **Fig. 68**
- Reworking sealing surface. See **Fig. 102**
- Removing and installing. See **CYLINDER HEAD, REMOVING AND INSTALLING**
- After replacement replace entire coolant amount

22. **Oil deflector**
23. **Cylinder head cover gasket**
    - Replace if damaged
    - Coat cylinder head/bearing cap transition points with D 454 300 A2 before installing
24. **Cylinder head cover**
    - With cable guide

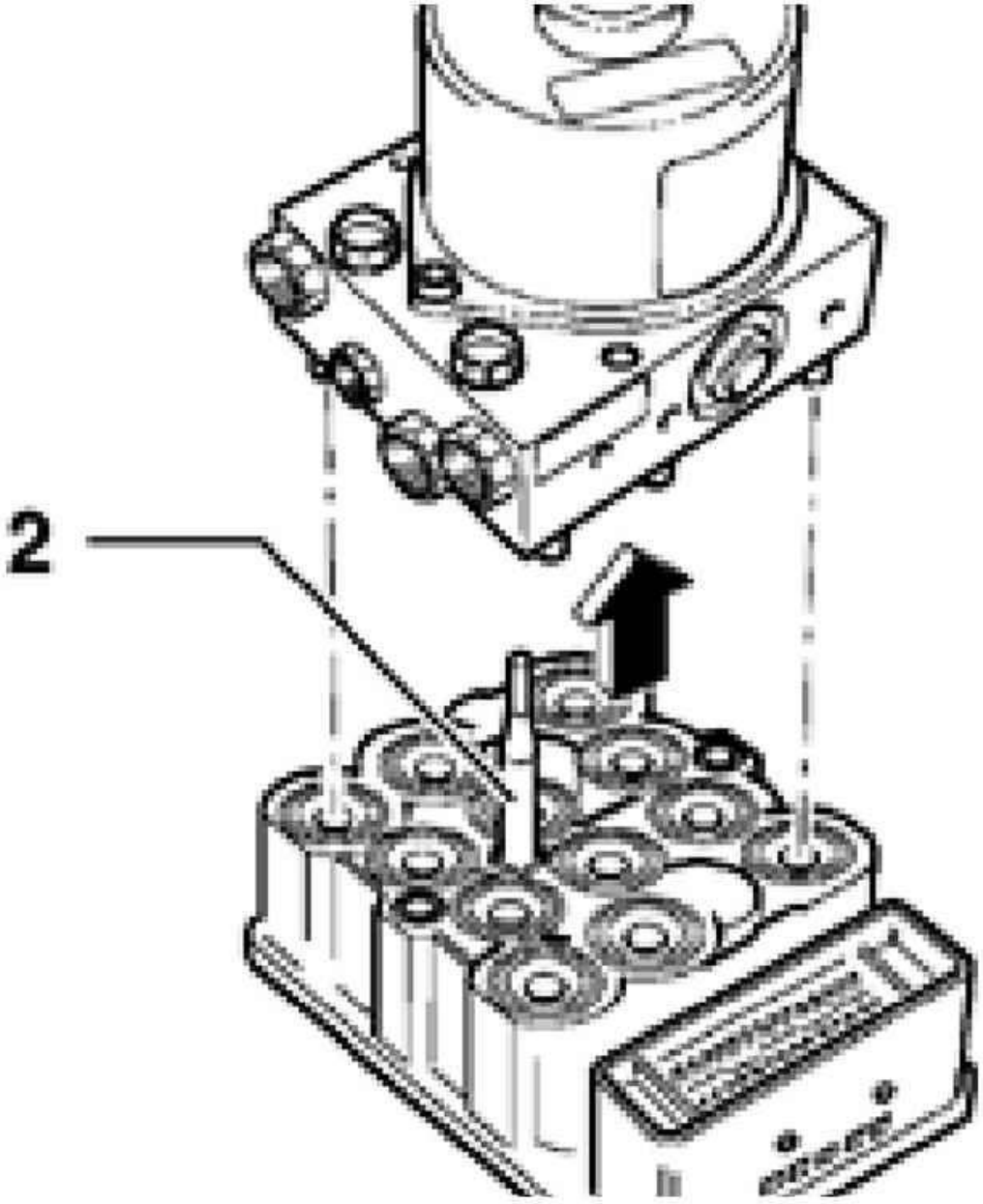


Fig. 67: Exploded View Of Cylinder Head Cylinder Head (Aluminum Cylinder Head Cover)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking Cylinder Head For Distortion

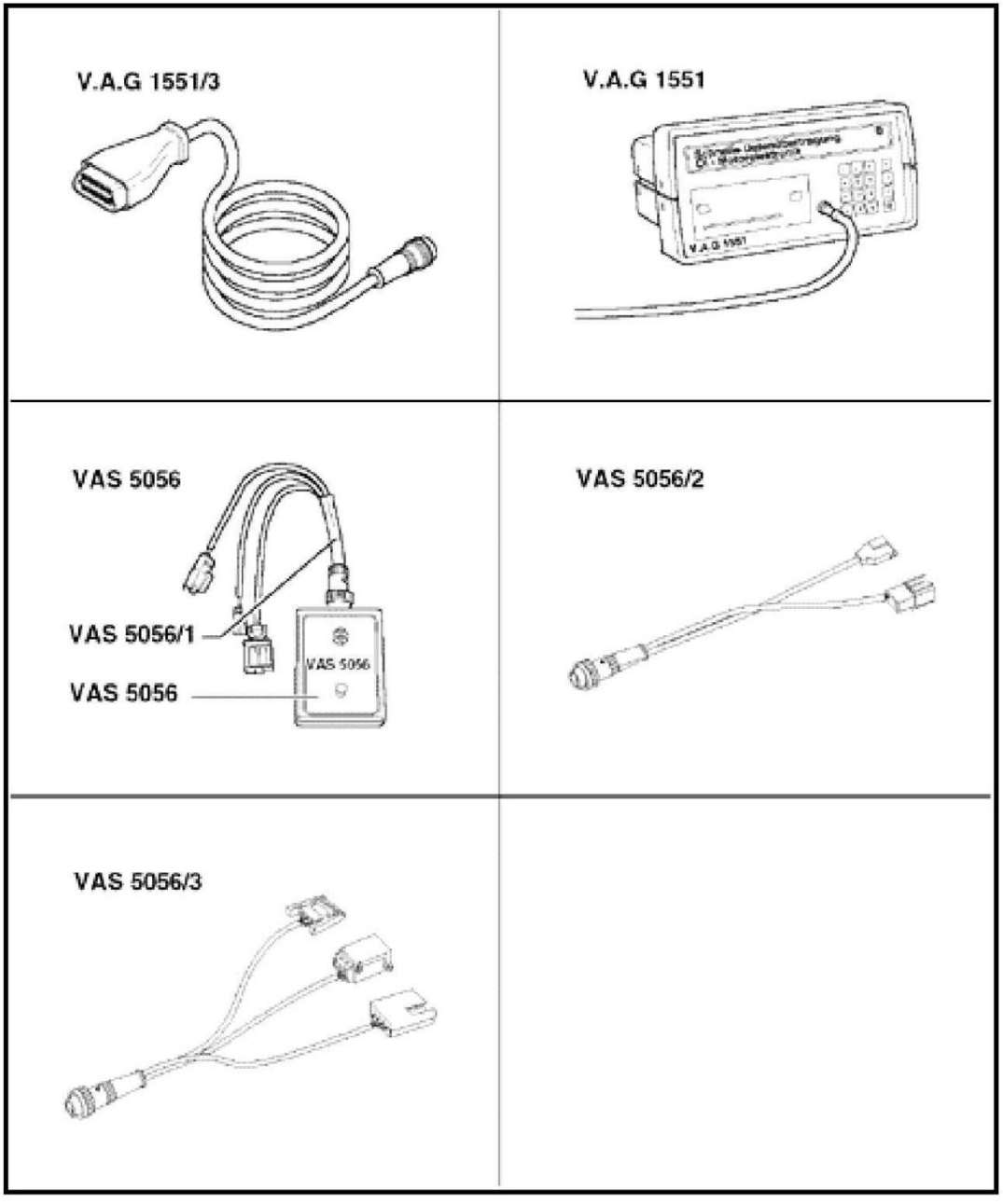


Fig. 68: Checking Cylinder Head For Distortion
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Max. permissible distortion: 0.1 mm

Toothed belts, removing, installing and tensioning

Adjusting valve timing.

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 10-222 A Support device (Modifying guide 10-222 A/21. See **MODIFYING GUIDE 10-222 A/21 FROM SUPPORT DEVICE 10-222 A**)
- 10-222 A/8 Adapter
- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)
- T 10020 Two-hole pin wrench

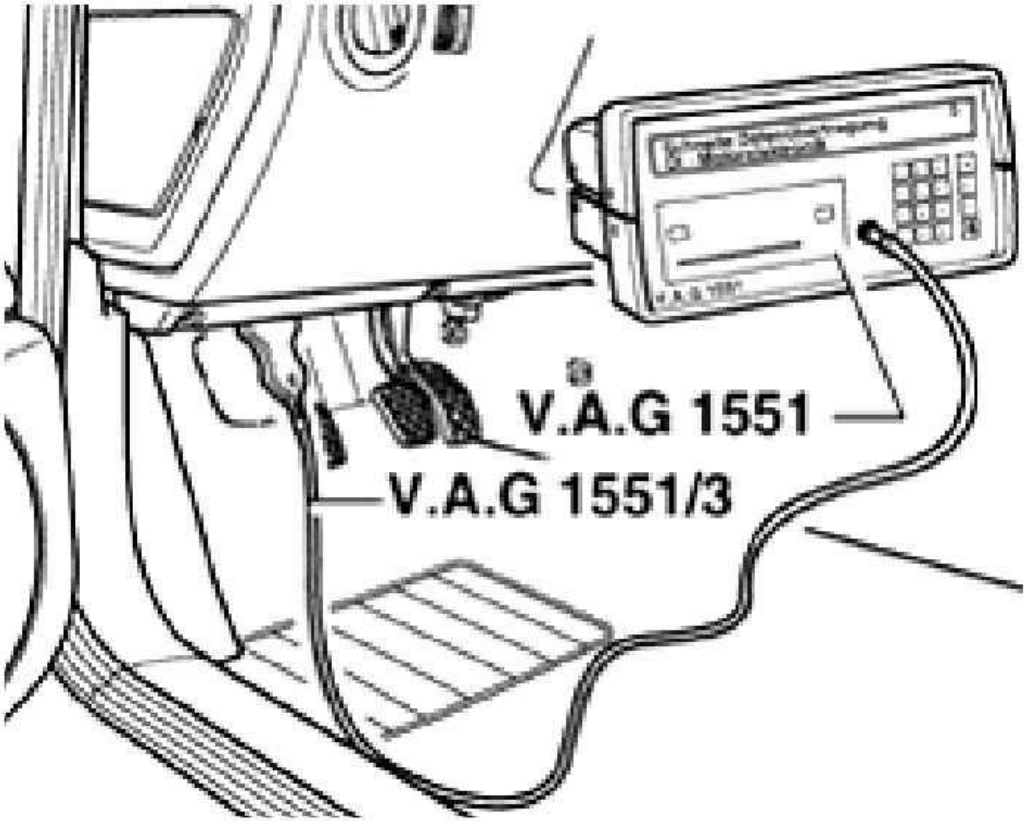


Fig. 69: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Modifying guide 10-222 A/21 from support device 10-222 A

Support device 10-222A is required to support engine/transmission assembly.

A new hole is required on guide 10-222 A/21 to secure adapter 10-222 A/8.

Fig. 70: Identifying 10-222 A/21 & 10-222 A/8
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dimensions given are in mm.

- Drill a 12.5 mm diameter (arrow) in guide 10-222 A/21.

Removing

- Remove engine cover.
- Removing right side insulation tray:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.
- Remove coolant expansion tank (coolant hoses remain connected).
- Remove toothed belt guard, upper part.
- Set camshaft pulley to TDC No. 1 cylinder by turning crankshaft.

  Mark on camshaft sprocket must align with arrow on toothed belt guard

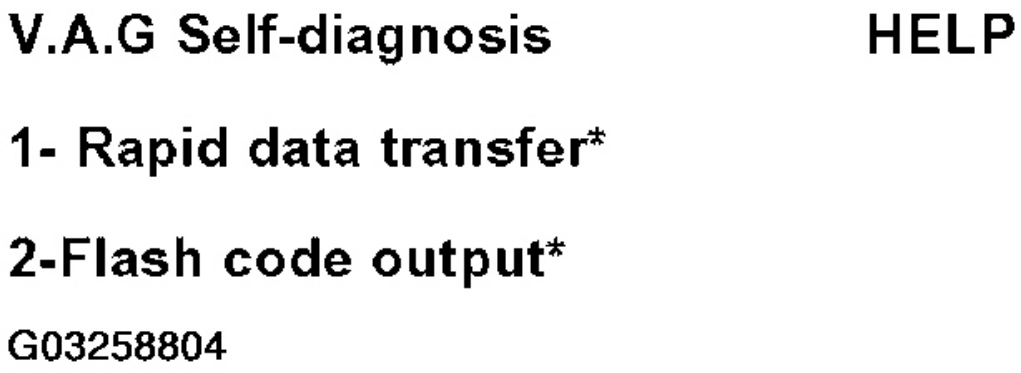


Fig. 71: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Mount support 10-222A with legs 10-222A/8 as shown.

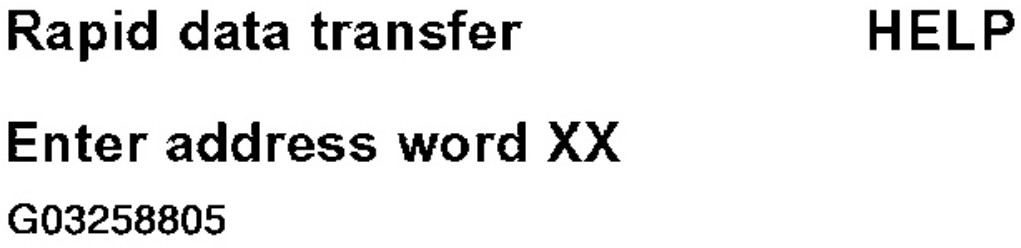


Fig. 72: Mounting Support With Legs On Engine
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove engine mounting -1- as follows:

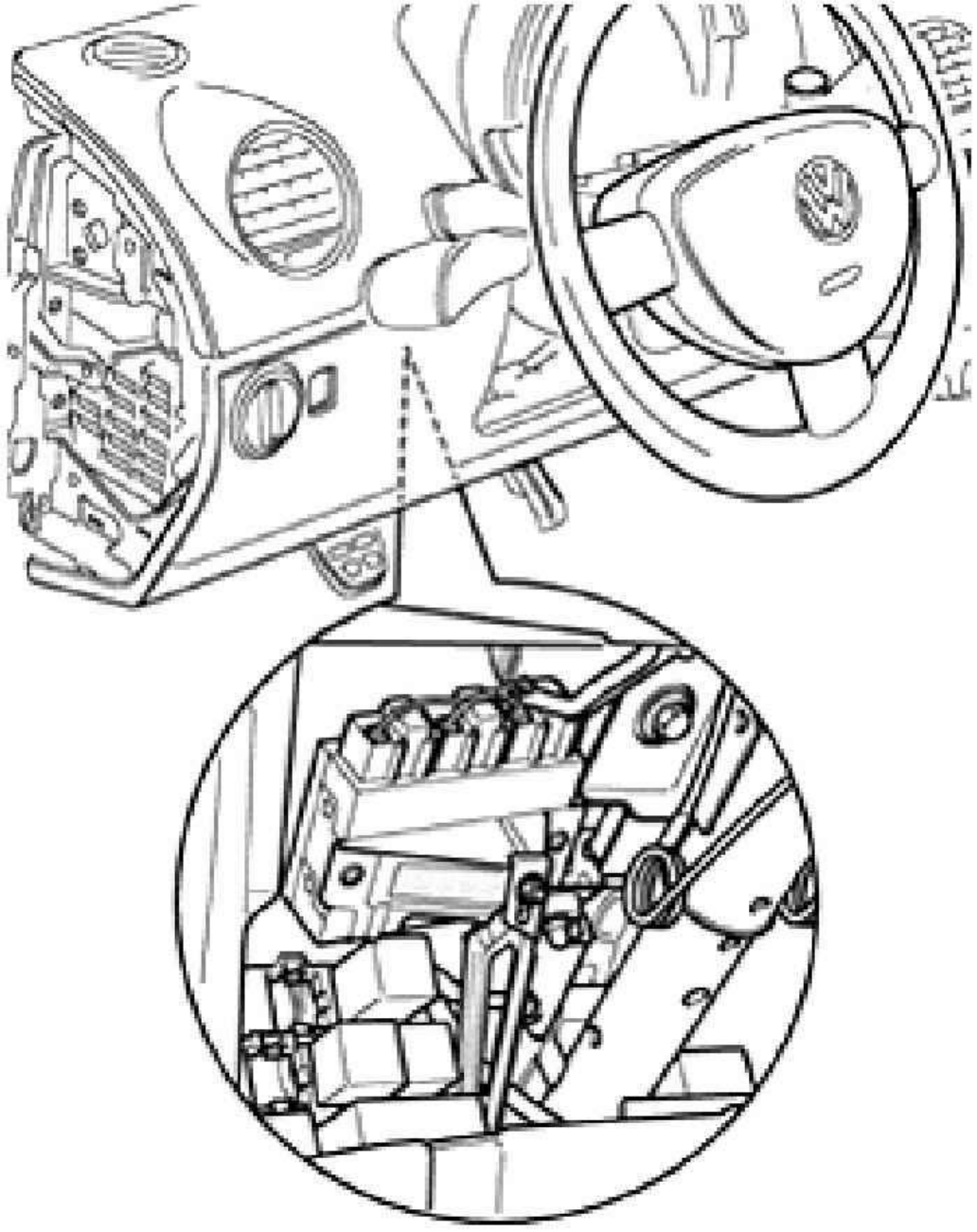


Fig. 73: Removing Engine Mounting
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove bolts (arrows).
- Loosen bolt (arrow -A-).

NOTE:

- **Only remove engine mounting when the engine is secured with the support bracket 10-222A.**
- **The engine bracket must be only released when the engine mounting is removed.**

- Remove vibration damper/belt pulley.

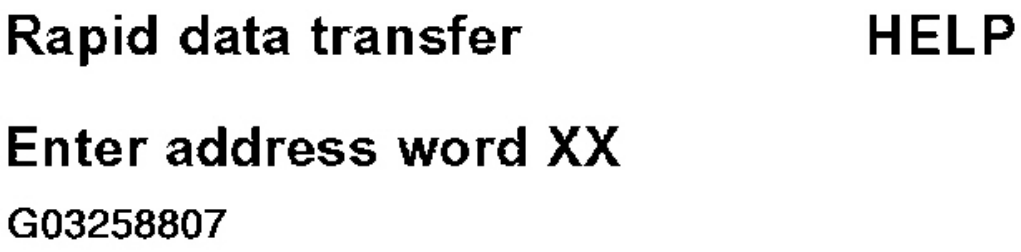


Fig. 74: Removing Vibration Damper/Belt Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove engine bracket from cylinder block.

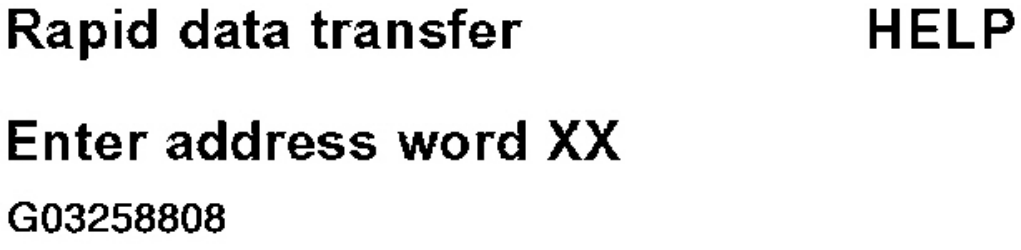


Fig. 75: Removing Engine Bracket From Cylinder Block
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When loosening the front engine mounting bolt the engine must be raised slightly with the support bracket.

- Remove toothed belt guard center and lower parts.
- Mark direction of rotation of toothed belt.
- Release tensioner and take off toothed belt.
- Turn crankshaft back slightly.

Installing

Requirements

- Pistons must not be positioned at TDC.

Work sequence

- Place toothed belt on crankshaft pulley and coolant pump (observe direction of rotation).

NOTE:

- **Engine removed:**

Begin by installing lower section of toothed belt guard as well as belt pulley/vibration damper.

Adjusting valve timing

NOTE: When the camshaft is turned, the crankshaft must not be at TDC. Danger of damage to valves or piston crowns.

- Bring mark on camshaft into line with mark on toothed belt guard.

  Engine installed:

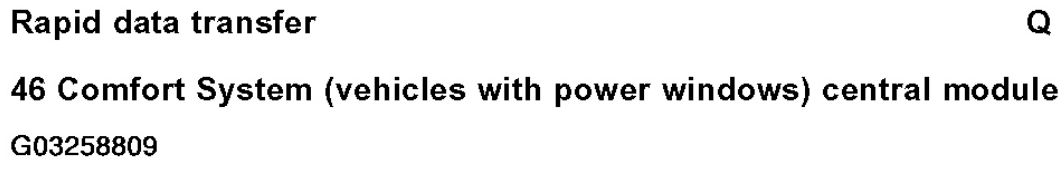


Fig. 76: Aligning Mark On Camshaft With Mark On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to TDC No. 1 cylinder (vehicles with manual transmission).

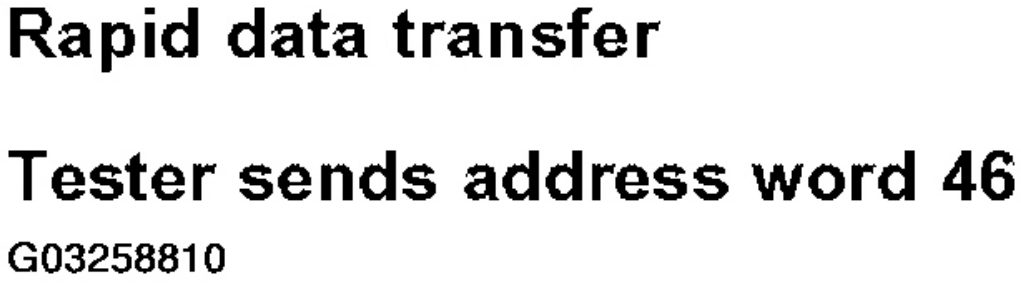


Fig. 77: Locating Mark For Positioning TDC No. 1 Cylinder (Vehicles With Manual Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Turn crankshaft to TDC No. 1 cylinder (vehicles with automatic transmission).

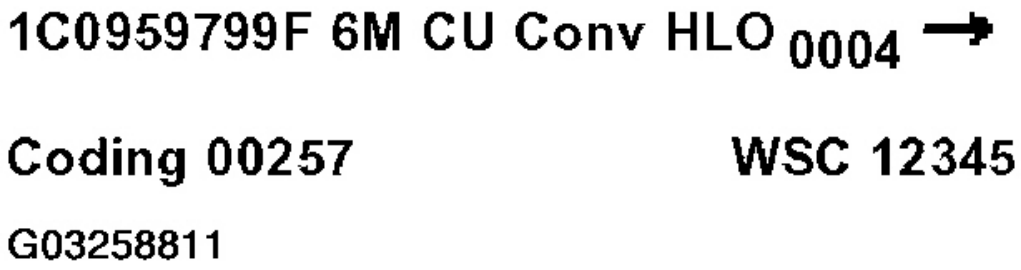


Fig. 78: Locating Mark For Positioning TDC No. 1 Cylinder (Vehicles With Automatic Transmission)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine removed:

- Position vibration damper at TDC No. 1 cylinder (arrows).

Fig. 79: Positioning Vibration Damper At TDC No. 1 Cylinder
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Place toothed belt on tensioning roller and camshaft pulley.

Tensioning toothed belt

Requirements

- Engine must only be hand touch warm.
- Camshaft sprocket is at TDC No. 1 cylinder.
- Before tensioning toothed belt, turn tensioning roller on eccentric with pin wrench T10020 five times fully onto limit stops in both directions.

Work sequence

- Tension toothed belt by turning eccentric to left (direction of arrow) with 2-hole pin wrench T10020 onto limit stop.

Fig. 80: Tensioning Toothed (Timing) Belt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Release tension on toothed belt until notch -1- and indicator -2- align (use mirror).
- Tighten securing nut to 20 N.m.

- Turn crankshaft two turns in engine direction of rotation until engine is again at TDC No. 1 cylinder. Last 45° (1/8 turn) must be completed without stopping.
- Check toothed belt tension again.

  Specification: Indicator and notch align

Continuation, install complete toothed belt

- Install toothed belt guard center and lower parts.
- Install vibration damper/belt pulley.

  Tightening torque: 25 N.m

- Install engine mounting to cylinder block.

  Tightening torque: 45 N.m

- Install engine assembly mountings complete.

  NOTE: Insert bolts into engine bracket before installing engine bracket.

- Align assembly mountings for engine and transmission. See **ENGINE AND TRANSMISSION MOUNTINGS, ALIGNING** .

  Tightening torques. See **ASSEMBLY MOUNTING** .

- Remove engine support bracket 10-222 A.
- Install toothed belt guard, upper part.
- Install ribbed belt tensioning element.

  Tightening torque: 25 N.m

- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Install coolant expansion tank.
- Install right side sound insulation tray:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW**

- Install engine cover.

Semi-automatic toothed belt tensioning roller, checking

Special tools, testers, measuring instruments and auxiliary items required

- T10020 Two hole pin wrench

Fig. 81: Identifying T10020 Two Hole Pin Wrench
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installed position

- Angled retainer (arrow) must locate in cutout on cylinder head.

Fig. 82: Locating Semi-Automatic Toothed Belt Tensioning Roller Angled Retainer
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Engine must only be hand touch warm.

Work sequence

- Set engine to TDC No. 1 cylinder.
- Press hard with thumb on toothed belt. Indicator -2- must move.

Fig. 83: Tensioning Toothed Belt
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Release thumb pressure on toothed belt and turn crankshaft two turns in engine direction of rotation until engine is again at TDC No. 1 cylinder. Last 45° (1/8 turn) must be performed without stopping.

  Tensioning roller must return to its original position (notch -1- and indicator -2- are again aligned).

NOTE: Use a mirror when checking.

Cylinder head, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- V.A.G 1306 Drip tray
- V.A.G 1332 Torque wrench (40...200 N.m)
- VAS 5024 Assembly tool for spring-type clips
- 3450/2A Guide pins
- 3450/3 Removal tool
- 3452 Key

Fig. 84: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- T10112 Installation tool

Fig. 85: Identifying T10112 Installation Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Engine must only be hand touch warm.

Work sequence

CAUTION: When performing repair work, especially due to the confined conditions in the engine compartment, pay attention to the following:

- **Route all types of lines (e.g. for fuel, hydraulics, EVAP system, coolant, refrigerant, brake fluid and vacuum) as well as electrical wiring so that the original positions are restored.**
- **Ensure sufficient clearance to all moving or hot components.**

NOTE: During the further course of work the battery Ground strap must be disconnected. Therefore, please check whether a coded radio is installed. Obtain the radio code first if necessary.

- With ignition switched off disconnect battery Ground strap.
- Remove engine cover.
- Drain coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Observe rules for cleanliness. See **RULES FOR CLEANLINESS** .

WARNING:

- **Fire Hazard! Do NOT have anything in the area that can ignite fuel!**
- **Fuel system is under pressure! Before opening the system**

place a cloth around the connection. Then release pressure by carefully loosening the connection.

Engine codes AEG, AVH, AZG

- Pull fuel supply line -3-, fuel return line -2- and vacuum line -1- off at connecting point.

Fig. 86: Removing Fuel Supply Line, Fuel Return Line And Vacuum Line (Engine codes AEG, AVH, AZG)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect hose from EVAP canister purge regulator valve -N80-.
- Disconnect fuel supply line -1- and fuel return line -2- from fuel rail and collect fuel that leaks out with a clean cloth.

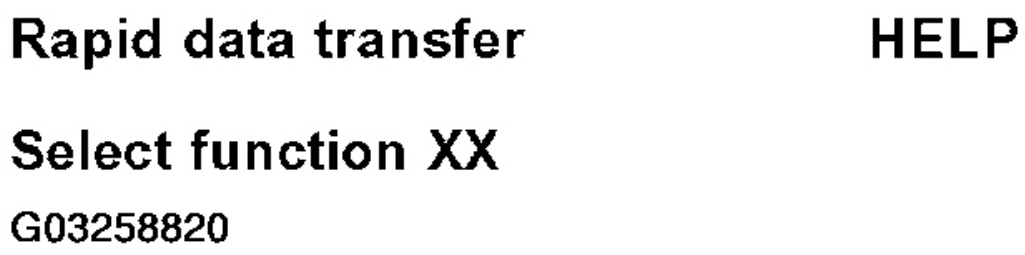


Fig. 87: Disconnecting Fuel Supply Line And Fuel Return Line From Fuel Rail (Engine Codes AEG, AVH, AZG)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine code BDC

- Disconnect fuel supply line -1- and fuel return line -2- at connection point on fuel rail.

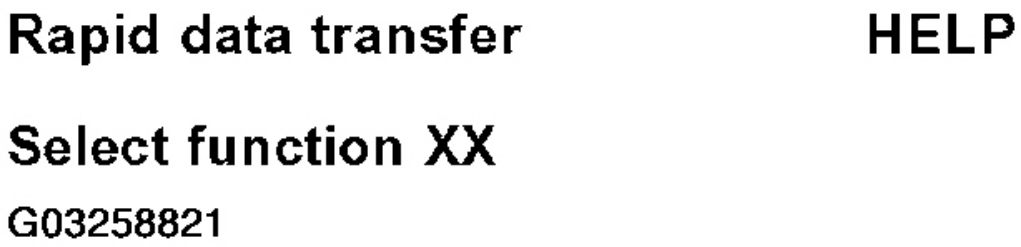


Fig. 88: Disconnecting Fuel Supply Line And Fuel Return Line (Engine Code BDC)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect hose from EVAP canister purge regulator valve -N80-.

Engine codes BEV, BGD

- Pull fuel supply line -1- off union by pressing locking ring -2- into union -3- and collect fuel that leaks out with a clean cloth.

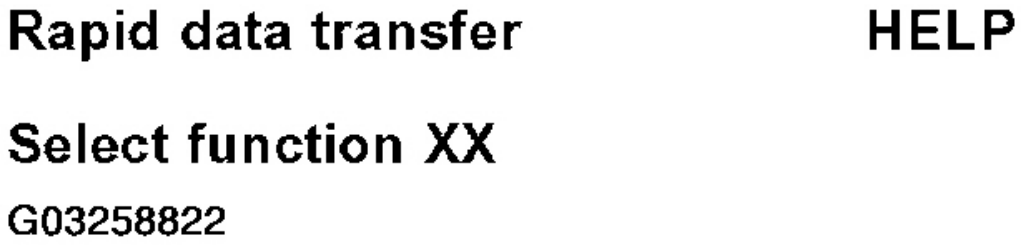


Fig. 89: Disconnecting Fuel Supply Line (Engine Codes BEV, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Continuation for all models

- Seal lines to avoid contamination of fuel system.
- Remove air cleaner assembly complete with air intake tube and secondary air injection tube. See **AIR CLEANER, DISASSEMBLING AND ASSEMBLING**
- Remove intake manifold upper part: See **INTAKE MANIFOLD UPPER PART, REMOVING AND INSTALLING**

NOTE: Seal the intake ports in the intake manifold lower section with clean cloths.

- Release all coolant, vacuum and intake hoses from intake manifold/cylinder head as required.
- Pull off/disconnect all electrical wiring as necessary on cylinder head and place to side.
- Disconnect coolant hose at connecting unions.
- Remove intake and pressure lines for secondary air injection pump.
- Remove pressure line bracket.
- Unbolt and remove secondary air injection pump motor and bracket.
- Disconnect following connectors:
  - -1- for Secondary Air Injection (AIR) pump motor -V101-, -2-

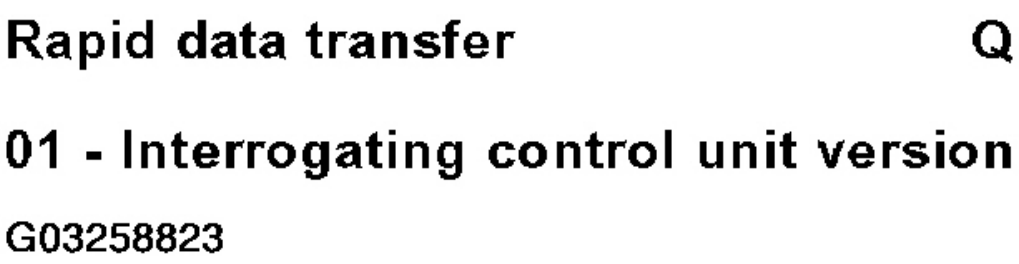


Fig. 90: Disconnecting Secondary Air Injection (AIR) Pump Motor Connector
Courtesy of VOLKSWAGEN OF AMERICA, INC.

  - For Camshaft Position (CMP) sensor -G40-
  - For Knock Sensor (KS) 1 -G61-
  - For injectors -N30-, -N31-, -N32-, -N33- (release from cable guide).
  - Engine Coolant Temperature (ECT) sensor -G62- (arrow).
- Remove harness for Knock Sensor 1 -G61- from clip on Generator bracket.

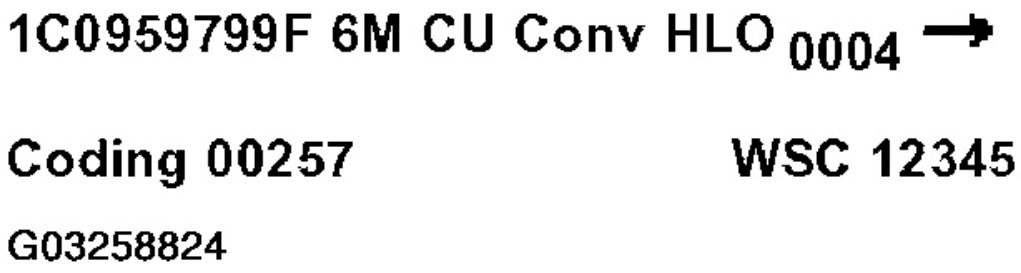


Fig. 91: Disconnecting Engine Coolant Temperature (ECT) Sensor Connector
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove clips securing fuel injector harness to fuel rail and place harness to side.
- Unclip wiring harness from left side of cylinder head.
- Remove ignition cables from spark plugs (use T10112).
- Unclip coolant recovery hose from bracket -1- on top of toothed belt tensioner.
- Remove bolt -2- securing oil dipstick tube to lower intake manifold.

Fig. 92: Removing Coolant Recovery Hose Clip
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove cover from oxygen sensor connectors on vehicle underside. See IDENTIFYING PIN CONNECTOR OF HEATED OXYGEN SENSOR under **ENGINE CODE BEV**
- Disconnect Heated Oxygen Sensor (HO2S) -G39- connector and unclip harness from exhaust heat shield.
- Remove front exhaust pipe with catalytic converter.
- Remove ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .
- Remove tensioning element for ribbed belt.

- Remove bracket (item - 4 -. See **PART I**) on tensioning element for ribbed belt.
- Remove toothed belt guard, upper part.
- Set camshaft pulley to TDC No. 1 cylinder by turning crankshaft.

  Mark on camshaft sprocket must align with arrow on toothed belt guard

Fig. 93: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Release tensioning roller and take toothed belt off camshaft pulley.
- Turn crankshaft back slightly.
- Remove cylinder head cover.
- Remove upper rear toothed belt guard bolt.
- Loosen socket head bolts in sequence given and then remove complete.

NOTE: Use tool 3452 for Polydrive cylinder head bolts.

Fig. 94: Loosening Sequence Of Cylinder Head Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Carefully lift cylinder head off.

Installing

NOTE:

- **Always replace cylinder head bolts.**
- **There must be no oil or coolant in the cylinder head bolt pockets in the cylinder head.**
- **Only remove the new cylinder head gasket from its packing immediately before installing.**
- **Handle the new gasket with extreme care. Damage will lead to leaks.**

- Place a clean cloth into cylinders so that no dirt or emery cloth particles can get in between cylinder wall and piston.
- Prevent dirt and emery cloth particles from getting into coolant.
- Carefully clean cylinder head and cylinder block sealing surfaces. Please ensure that no scoring or scratches are formed (when using abrasive paper grade must not be less than 100).
- Carefully remove metal particles, emery remains and cleaning cloths.
- If crankshaft has been turned: Set No. 1 cylinder piston to top dead center and then turn crankshaft back slightly.
- To centralize, screw guide pins from 3450/2A into front outer holes for cylinder head bolts.

Fig. 95: Centralizing Guide Pins
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install new cylinder head gasket.

NOTE: Lettering (part number) must be readable.

- Install cylinder head, thread in 8 remaining cylinder head bolts and tighten by hand.
- Remove guide pins through bolt holes with extractor 3450/3. Extractor must be turned to left (counter-clock wise) until pins are free.
- Install remaining cylinder head bolts and tighten hand-tight.
- Tighten cylinder head bolts in prescribed tightening sequence as follows:
  - Pretighten all bolts to 40 N.m.
  - Then tighten all bolts 1/4 turn (90°) turn further with a rigid wrench.

- Then tighten all bolts again 1/4 turn (90°) further.

Fig. 96: Tightening Sequence Of Cylinder Head Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

The rest of the assembly is basically in reverse order to the disassembly sequence.

NOTE: When the camshaft is turned, the crankshaft must not be at TDC. Danger of damage to valves or piston crowns.

- Install cylinder head cover and tighten nuts.

  Tightening torque: 10 N.m

- Install toothed belt and adjust timing. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .
- Install ribbed belt tensioning element.

  Tightening torque: 25 N.m

- Install ribbed belt. See **RIBBED BELT, REMOVING AND INSTALLING** .

NOTE: All cable ties which are opened or cut open to remove the cylinder head must be replaced in the same position when re-installing the cylinder head.

- Fill with new coolant. See **COOLING SYSTEM, DRAINING AND FILLING** .
- Connect battery Ground (GND) strap.

Vehicles without EPC

- Adjust accelerator cable. See **ACCELERATOR MECHANISM, SERVICING** .

Continuation for all models

- Adapt (match) engine control module to throttle valve control module. See **COMPONENTS AND FUNCTIONS, ADAPTING** .
- Road test vehicle and interrogate all fault memories:

  Observe the valid safety precautions when performing a road test. See **SAFETY PRECAUTIONS** .

- If fault memory has been erased or engine control module was disconnected from permanent positive, respective components must be adapted to engine control module and readiness code generated again. See **COMPONENTS AND FUNCTIONS, ADAPTING** .
- Read readiness code.

Vehicles with automatic transmission

- Adapt transmission control module:

  For 01M, see **BASIC SETTING, INITIATING** .

  For 09G, see **BASIC SETTING, INITIATING** .

- Test drive vehicle and interrogate fault memory.

COMPRESSION PRESSURES, CHECKING

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 3122 B Spark plug wrench
- T10112 Removal tool
- V.A.G 1331 Torque wrench (5..50 N.m)
- V.A.G 1763 Compression tester

Fig. 97: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Requirements

- Engine oil temperature must be at least 30°C.
- Voltage supply OK.
- All electrical consumers, e.g. lights and rear window defogger must be switched off.
- If the vehicle is equipped with air conditioning, this must be switched off.
- On models with an automatic transmission selector lever in position "P" or "N"

Work sequence

- Remove engine cover.
- Disconnect 6-pin connector from ignition coil with final output stage (arrow).

  Engine code AEG

Fig. 98: Locating Engine Code AEG
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Engine codes AVH, AZG, BDC, BEV, BGD

Fig. 99: Locating Engine Codes AVH, AZG, BDC, BEV, BGD
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pull fuse No. 32 out of fuse holder. Fuse box located under access cover at far left end of dash.

NOTE: Removing the fuse interrupts the voltage supply to the injectors.

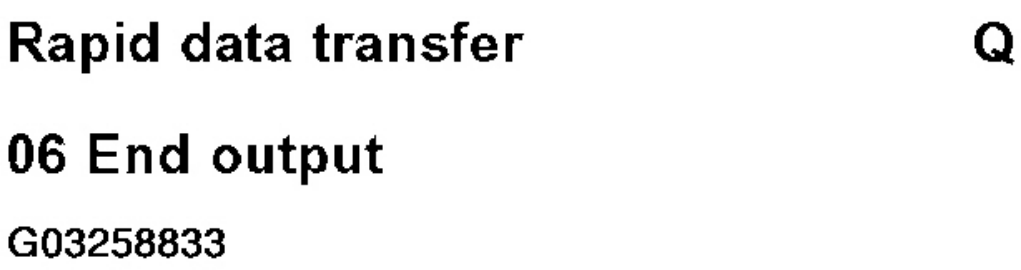


Fig. 100: Locating Fuses
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect connectors for outer injectors.
- Disconnect spark plug connectors with tool T10012
- Remove spark plugs with spark plug wrench 3122B.
- Check compression pressures using compression tester V.A.G 1763 and adapter V.A.G 1763/6.

NOTE: To use the compression tester. See Operating instructions.

Vehicles without EPC

- Have a second technician fully depress accelerator pedal.

Continuation for all models

- Have a second technician operate starter motor.
- Operate starter until tester shows no further pressure increase.

Compression pressure values

New: 10...13 bar

Wear limit: 7.5 bar

Permissible difference between all cylinders: 3 bar

- Adapt (match) engine control module to throttle valve control module. See **COMPONENTS AND FUNCTIONS, ADAPTING** .

- If fault memory has been erased or engine control module was disconnected from permanent positive, respective components must be adapted to engine control module and readiness code generated again. See **COMPONENTS AND FUNCTIONS, ADAPTING** .

VALVE GEAR, SERVICING

NOTE:

- **Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first four spark plug threads are cracked.**
- **When new lifters have been installed the engine must not be started for about 30 minutes. (Otherwise valves will contact pistons) Then, finally, rotate crankshaft two complete revolutions.**

NOTE: The following list refers to items in Fig. 101 .

1. **100 N.m**
   - Use counter support tool 3415 to loosen and tighten
2. **Camshaft pulley**
3. **Seal**
   - Replacing. See **CAMSHAFT OIL SEAL, REPLACING**
4. **Woodruff key**
   - Check if seated securely
5. **20 N.m**
6. **Bearing cap**
   - Installation position. See **Fig. 104**
   - Installation sequence. See **CAMSHAFT, REMOVING AND INSTALLING**
   - Coat contact surfaces of bearing cap 1 lightly with sealing compound AMV 174 004 01.
7. **Camshaft**
   - Checking axial clearance. See **Fig. 103**
   - Removing and installing. See **CAMSHAFT, REMOVING AND INSTALLING**
   - Check radial clearance with Plastigage, Wear limit: 0.1 mm
   - Run-out: max. 0.05 mm
8. **Hydraulic lifter**
   - Do not interchange
   - With hydraulic valve clearance compensation
   - Checking. See **HYDRAULIC LIFTERS, CHECKING**
   - Store with cam contact surface downward
   - Before installing check camshaft axial clearance. See **Fig. 103**

- Oil contact surface

9. **Keepers**
10. **Valve spring upper plate**
11. **Valve spring**
    - Removing and installing with cylinder head removed: With 2037; with cylinder head installed: See **VALVE STEM SEALS, REPLACING**
12. **Valve stem seal**
    - Replacing. See **VALVE STEM SEALS, REPLACING**
13. **Valve guide**
    - Checking. See **VALVE GUIDES, CHECKING**
    - Replacing. See **VALVE GUIDES, REPLACING**
    - Repair version with shoulder
14. **Cylinder head**
    - Reworking sealing surface. See **Fig. 102**
    - Reworking valve seats. See **VALVE SEATS, REWORKING**
15. **Valves**
    - Do not rework, only lapping is permitted
    - Valve dimensions. See **Fig. 105**

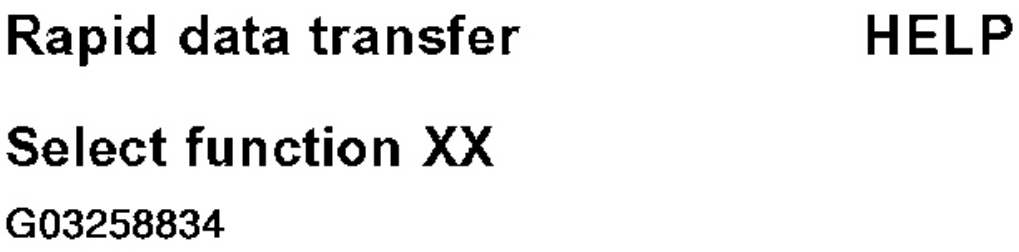


Fig. 101: Disassembled View Of Valve Gear
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Reworking cylinder head sealing surface

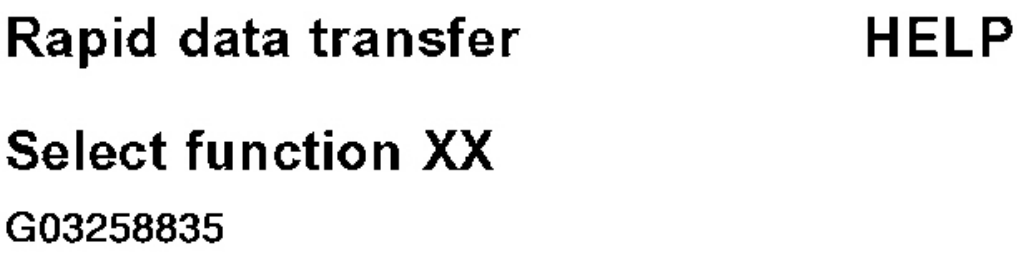


Fig. 102: Identifying Cylinder Head Reworking Dimension (Cylinder Head Height)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Cylinder head reworking dimension: -a- = min. 132.6 mm

NOTE: When the sealing surface has been reworked, the valves must be set deeper by the same amount.

Checking Camshaft Axial Clearance

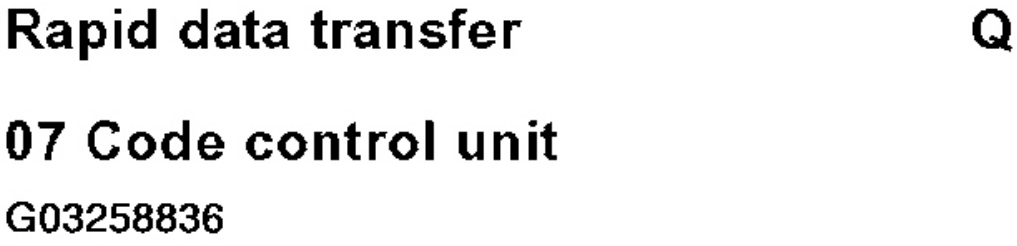


Fig. 103: Checking Camshaft Axial Clearance
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Special tools, testers, measuring instruments and auxiliary items required

- Universal dial gauge bracket VW 387
- Dial gauge

Check with hydraulic lifters removed and with first and last bearing caps installed.

Wear limit: max. 0.15 mm

Installed position of camshaft bearing caps

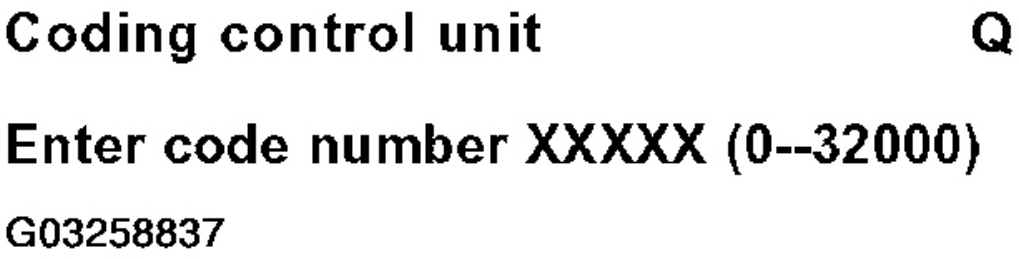


Fig. 104: Identifying Installed Position Of Camshaft Bearing Caps
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Note offset. Before installing camshaft fit bearing caps and determine installed position.

Valve dimensions

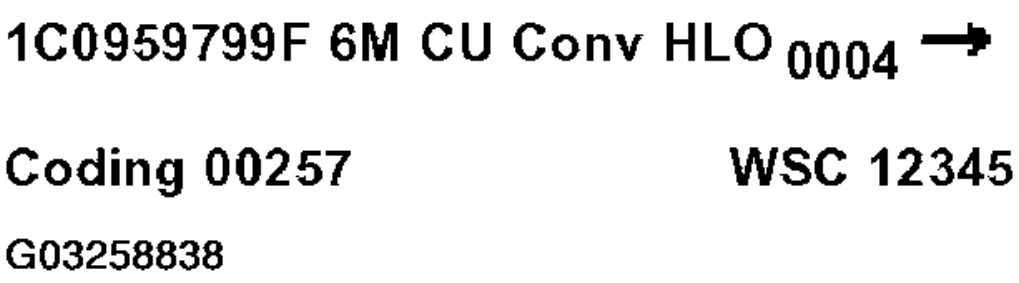


Fig. 105: Identifying Valve Dimensions
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Valves must not be reworked. Only lapping is permitted.

Engine code AEG

VALVE DIMENSIONS SPECIFICATIONS (ENGINE CODE AEG)

Dimension	Intake valve	Exhaust valve
Dia. a -	39.5 +/- 0.15	32.9 +/- 0.15
Dia. b - mm	6.92 + 0.02	6.92 + 0.02
Length c - mm	91.85	91.15
Angle a - degrees	45	45

Engine codes AVH, AZG, BDC, BEV, BGD

VALVE DIMENSIONS SPECIFICATIONS (ENGINE CODES AVH, AZG, BDC, BEV, BGD)

Dimension	Intake valve	Exhaust valve
Dia. a - mm	39.5 +/- 0.15	32.9 +/- 0.15
Dia. b - mm	6.98 +/- 0.007	6.96 +/- 0.007
Length c - mm	91.85	91.15
Angle a - degrees	45	45

Valve seats, reworking

Special tools, testers, measuring instruments and auxiliary items required

- Depth gauge
- Valve seat refacing tool

NOTE:

- **When repairing engines with leaking valves, it is not sufficient to rework or replace valve seats and valves. It is also necessary to check the valve guides for wear. This particularly important on high mileage engines.**
- **The valve seats should only be reworked just enough to produce a perfect seating pattern. The maximum permissible reworking dimension must be calculated before reworking commences. If the reworking dimension is exceeded, the function of the hydraulic lifters can no longer be guaranteed and the cylinder head should be replaced.**

Calculating maximum permissible reworking dimension

- Insert valve and press firmly against seat.

NOTE: **If the valve is to be replaced as part of a repair, use a new valve for the measuring.**

- Measure distance -a- between end of valve stem and upper edge of cylinder head.

Fig. 106: Measuring Distance Between End Of Valve Stem And Upper Edge Of Cylinder Head
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Calculate maximum permissible reworking dimension from measured distance -a- and minimum dimension.

  Minimum dimensions:

  Intake valve 33.8 mm

  Exhaust valve 34.1 mm

Measured distance -a- minus minimum dimension = maximum permissible reworking dimension.

Example:

CALCULATING MAXIMUM PERMISSIBLE REWORKING DIMENSION (EXAMPLE)

Measured distance -a-	35.1 mm
Minimum dimension - 34.1	mm
= max. perm. Rework dimension (1)	1.0 mm
(1) The maximum permissible reworking dimension is shown as dimension "b" in illustrations for reworking of valve seats.	

Reworking intake valve seat

INTAKE VALVE SEAT DIMENSION SPECIFICATIONS

Dimension	**Intake valve seat**
Dia. a - mm	39.2
b - mm	max. permissible reworking dimension
c - mm	1.8...2.2

Z	Cylinder head lower edge
45°	Valve seat angle
30°	Upper correction angle

Fig. 107: Reworking Intake Valve Seat
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Reworking exhaust valve seat

EXHAUST VALVE SEAT DIMENSION SPECIFICATIONS

Dimension	**Exhaust valve seat**
Dia. a - mm	32.4
Dia. b - mm	max. permissible reworking dimension
c - mm	2.2...2.6
Z	Cylinder head lower edge
45°	Valve seat angle
30°	Upper correction angle

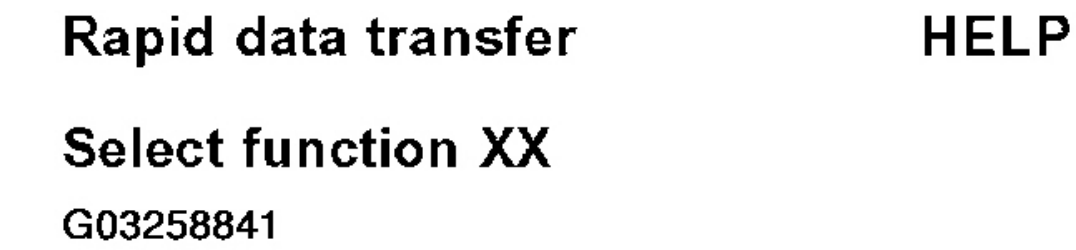


Fig. 108: Reworking Exhaust Valve Seat
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Camshaft oil seal, replacing

For coil spring seals:

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 10-203 Puller
- 2085 Oil seal extractor
- 3415 Counterhold
- V.A.G1331 Torque wrench (5 ... 50 N.m)
- V.A.G 1332 Torque wrench (40 ... 200 N.m)

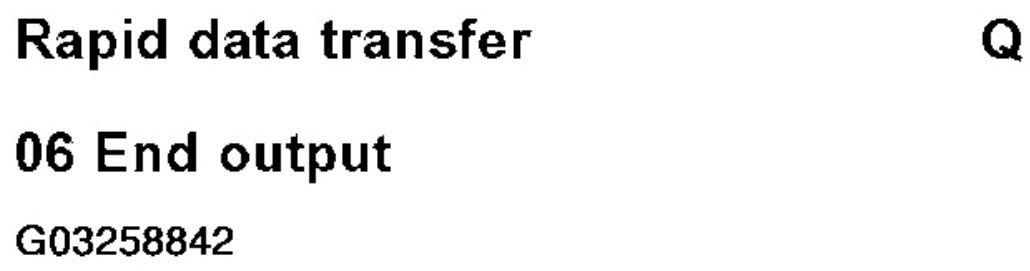


Fig. 109: Identifying Special Tools (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

For PTFE seals:

- 2085 Oil seal extractor
- 3415 Counter support
- T10071 Puller
- V.A.G 1331 Torque wrench (5..50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)

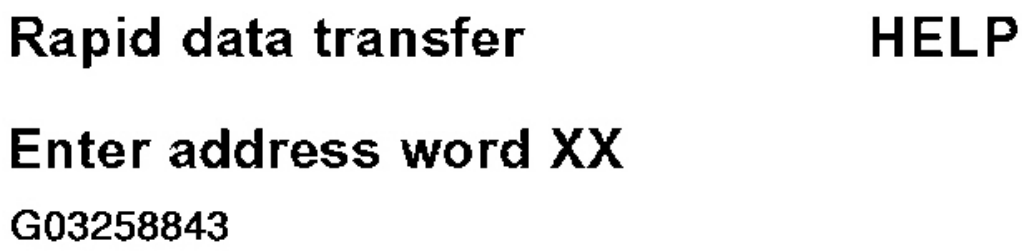


Fig. 110: Identifying Special Tools (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove toothed belt guard, upper part.
- Set camshaft pulley to TDC No. 1 cylinder by turning crankshaft.

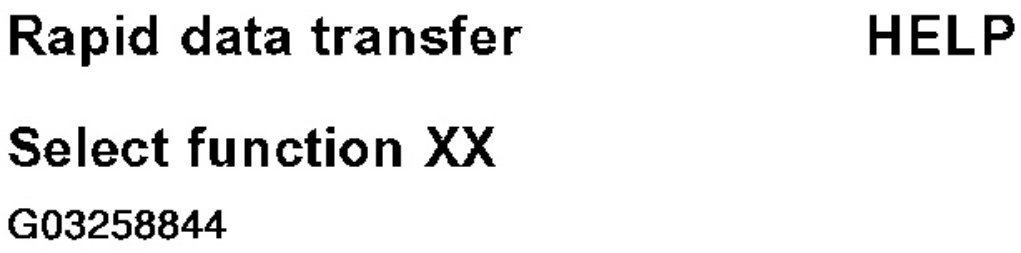


Fig. 111: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Mark on camshaft sprocket must align with arrow on toothed belt guard

- Release tensioning roller and take toothed belt off camshaft pulley.
- Turn crankshaft back slightly.
- Remove camshaft pulley. To loosen camshaft pulley securing bolt, hold pulley with counter support 3415

Fig. 112: Removing Camshaft Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove woodruff key from camshaft.
- Screw camshaft pulley securing bolt fully into camshaft onto limit stop.
- Unscrew inner part of oil seal extractor 2085 two turns (approx. 3 mm) out of outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it into oil seal as far as possible.

Fig. 113: Removing Camshaft Oil Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.
- Clamp flats of oil seal extractor in a vice. Remove oil seal with pliers.

Installing

Requirements

- Pistons must NOT be positioned at TDC.

NOTE: A PTFE seal (Teflon) -2 is gradually being introduced instead of the inner coil spring seal -1-. This has a wider sealing lip. PTFE oil seals are installed free of oil and grease. A radial shaft seal of older design (with coil spring) may be replaced with a PTFE oil seal, but not vice versa. When a PTFE oil seal is installed, then only such an oil seal may be installed as a replacement part!

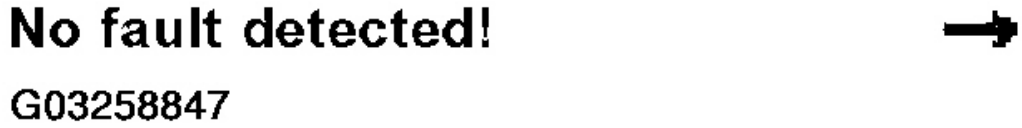


Fig. 114: Identifying Oil Seals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

PTFE sealing rings

NOTE: Do not additionally oil or grease the oil seal sealing lip.

- Position oil seal with guide sleeve T10071 and press in onto limit stop with press sleeve T10071/1 and bolt T10071/2.

Coil spring seals

NOTE: Oil or grease lightly the oil seal sealing lip.

- Position oil seal with guide sleeve 10-203 and press in onto limit stop with press sleeve and bolt from 10-203.

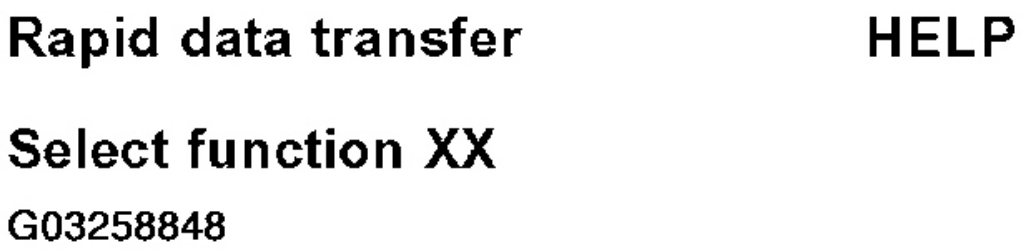


Fig. 115: Installing Cam Shaft Oil Seal With Guide Sleeve
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Continuation for all seals

- Insert woodruff key in camshaft.
- Install camshaft pulley. To tighten securing bolt counter support camshaft pulley with 3415.

  Tightening torque: 100 N.m

  NOTE: When the camshaft is turned, the crankshaft must not be at TDC. Danger of damage to valves or piston crowns.

  The rest of the assembly is basically in reverse order to the disassembly sequence.

Fig. 116: Installing Camshaft Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing toothed belt and adjusting timing. See **TOOTHED BELTS, REMOVING, INSTALLING**

AND TENSIONING .

Camshaft, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 3415 Counter support
- V.A.G 1331 Torque wrench (5...50 N.m)
- V.A.G 1332 Torque wrench (40...200 N.m)
- AMV174 004 01 Sealant

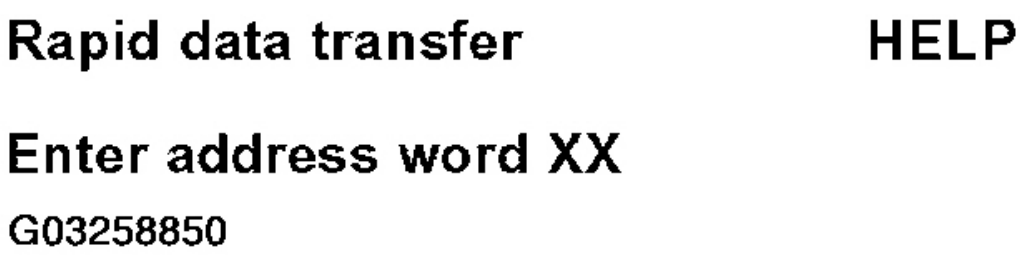


Fig. 117: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove engine cover.
- Remove intake manifold upper part. See **INTAKE MANIFOLD UPPER PART, REMOVING AND INSTALLING** .

NOTE: Seal the intake ports in the intake manifold lower section with clean cloths.

- Remove toothed belt guard, upper part.
- Set camshaft pulley to TDC No. 1 cylinder by turning crankshaft.

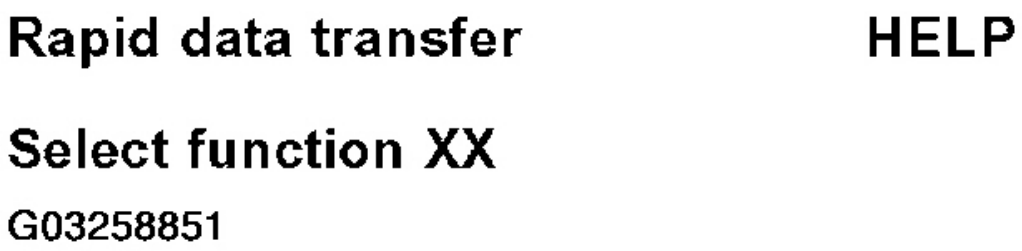


Fig. 118: Aligning Mark On Camshaft Sprocket With Arrow On Toothed Belt Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Mark on camshaft sprocket must align with arrow on toothed belt guard.

- Release tensioning roller and take toothed belt off camshaft pulley.
- Turn crankshaft back slightly.
- Remove camshaft pulley. To loosen camshaft pulley securing bolt, hold pulley with counter support 3415

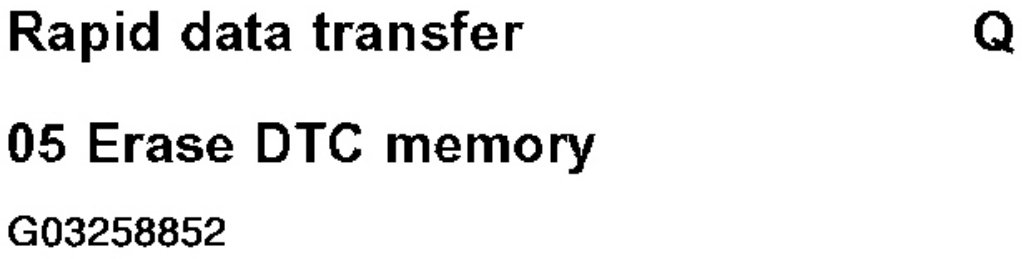


Fig. 119: Removing Camshaft Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove woodruff key from camshaft.
- Remove cylinder head cover.
- First remove bearing caps 5, 1 and 3. Loosen bearing caps 2 and 4 alternately and diagonally.

Installing

Requirements

- Pistons must not be positioned at TDC.

NOTE:

- **When installing the camshaft, the cam lobes for cylinder 1 must face upward.**
- **When installing the bearing cap note offset. Before installing camshaft fit bearing caps and determine installed position.**

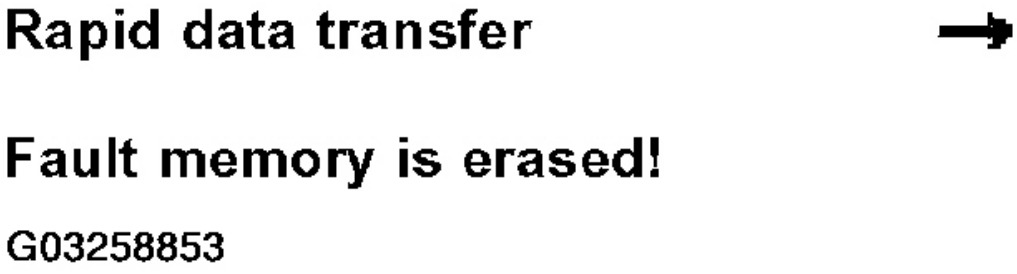


Fig. 120: Identifying Correct Installation Of Camshaft Bearing Cap
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Work sequence

- Oil running surfaces on camshaft.
- Install camshaft.
- Tighten bearing caps 2 and 4 alternately and diagonally to 20 N.m.
- Coat contact surfaces of bearing cap 1 lightly with sealing compound AMV 174 004 01.
- Install bearing caps 3, 1 and 5 and also tighten to 20 N.m.
- Insert woodruff key in camshaft.
- Install camshaft pulley. To tighten securing bolt counter support camshaft pulley with 3415.

  Tightening torque: 100 N.m

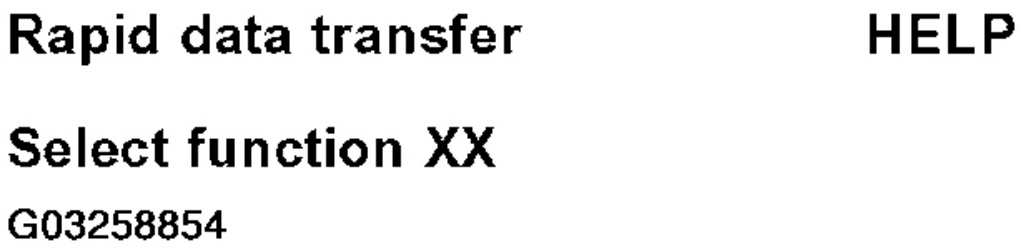


Fig. 121: Installing Camshaft Pulley
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When the camshaft is turned, the crankshaft must not be at TDC. Danger of damage to valves or piston crowns.

The rest of the assembly is basically in reverse order to the disassembly sequence.

Installing toothed belt and adjusting timing. See **TOOTHED BELTS, REMOVING, INSTALLING AND TENSIONING** .

NOTE: When new lifters have been installed the engine must not be started for about 30 minutes. The hydraulic compensation elements must settle (otherwise valves will strike pistons).

Hydraulic lifters, checking

Special tools, equipment, testers, measuring instruments and auxiliary items required

- Feeler gauge
- Wooden or plastic wedge

NOTE:

- **Replace faulty hydraulic lifters complete only (can not be adjusted or serviced).**
- **Irregular valve noises when starting engine are normal.**

Work sequence

- Start engine and run until coolant fan has switched on once.
- Increase engine speed to about 2500 RPM for approx. 2 minutes.

If the hydraulic lifters are still noisy, locate faulty lifters as follows:

- Remove intake manifold upper part. See **INTAKE MANIFOLD UPPER PART, REMOVING AND INSTALLING** .

NOTE: Seal the intake ports in the intake manifold lower section with clean cloths.

- Remove cylinder head cover.
- Rotate crankshaft clockwise, until cam of lifter to be checked is pointing upward.
- Determine clearance between cam lobe and hydraulic lifter.
- If clearance is greater than 0.2 mm, replace hydraulic lifter. If clearance is less than 0.1 mm or no clearance exists, then proceed with check as follows:
- Push hydraulic lifter down lightly with a wooden or plastic wedge. If when hydraulic lifter is pushed down a 0.2 mm thick feeler gauge can be inserted between camshaft and hydraulic lifter, lifter is to be replaced.

Fig. 122: Pushing Hydraulic Lifter
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: When new lifters have been installed the engine must not be started for about 30 minutes. The hydraulic compensation elements must settle (otherwise valves will strike pistons).

Valve guides, checking

Special tools, equipment, testers, measuring instruments and auxiliary items required

- VW 387 Universal dial gauge bracket
- Dial gauge

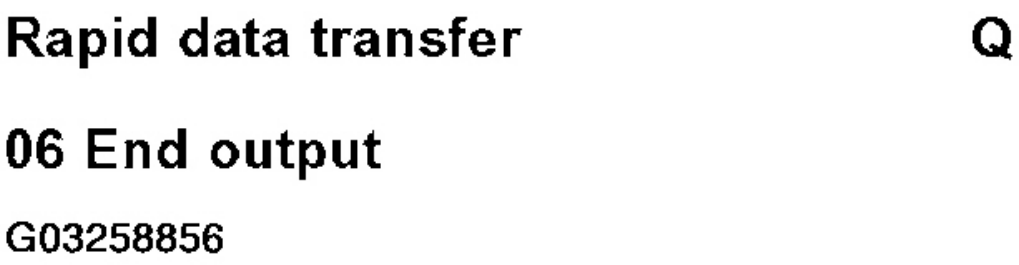


Fig. 123: Identifying Special Tool
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Work sequence

- Insert a new valve into guide. End of valve stem must be flush with guide. Due to slight difference in stem diameters, ensure that only an intake valve is used in intake guide and an exhaust valve in exhaust guide.

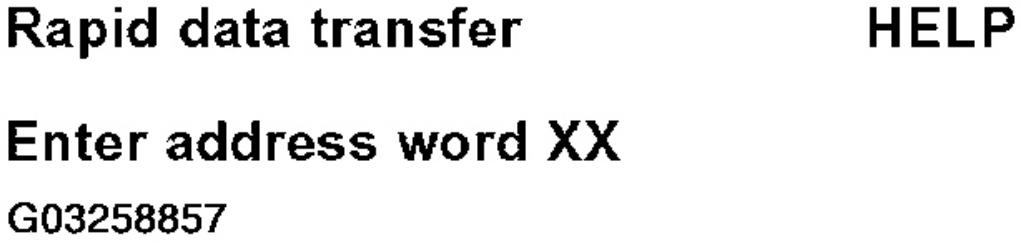


Fig. 124: Checking Valve Guide Wear (Valve Rock)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Determine rock.

  Wear limit:

  Intake valve guide = 1.0 mm

  Exhaust valve guide = 1.3 mm

Valve guides, replacing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 3121 Drift

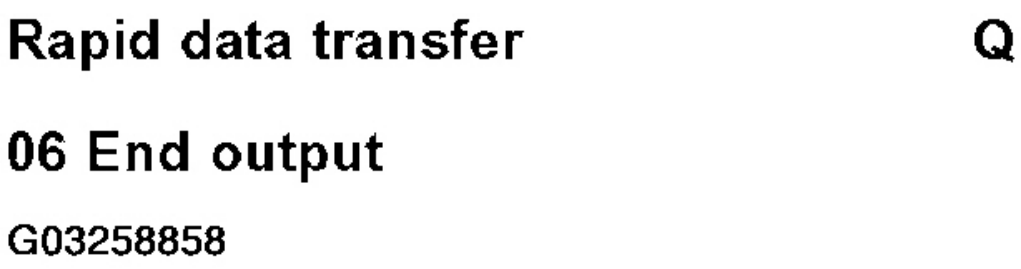


Fig. 125: Identifying 3121 Drift
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- 3120 Reamer and cutting fluid

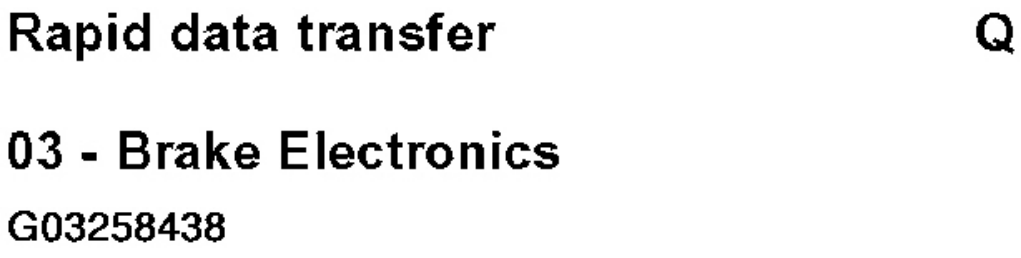


Fig. 126: Identifying 3120 Reamer & Cutting Fluid
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Clean and check cylinder head. Cylinder heads in which valve seats can no longer be reworked. Note minimum dimension. See **VALVE SEATS, REWORKING** . Cylinder heads which have already been machined to minimum dimension, should not have valve guides replaced. See **Fig. 102** .
- Press out worn valve guides with drift 3121 from camshaft side (repair version guides, with a shoulder,

from combustion chamber side).

Installing

- Press in new guides, moistened with oil, from camshaft side onto shoulder in cold cylinder head using drift 3121.

NOTE: When the shoulder on guide makes contact the pressure must not exceed 10kN (approx. 1.0 t) otherwise the shoulder may break off.

- Ream valve guide using hand reamer 3120. Always use cutting fluid when doing this.
- Reworking valve seats. See **VALVE SEATS, REWORKING** .

Valve stem seals, replacing

(with cylinder head installed)

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 2036 Assembly device
- 3047A Puller
- 3122 B Spark plug wrench
- 3129 Installation tool
- T10112 Installation tool
- V.A.G 1331 Torque wrench (5..50 N.m)

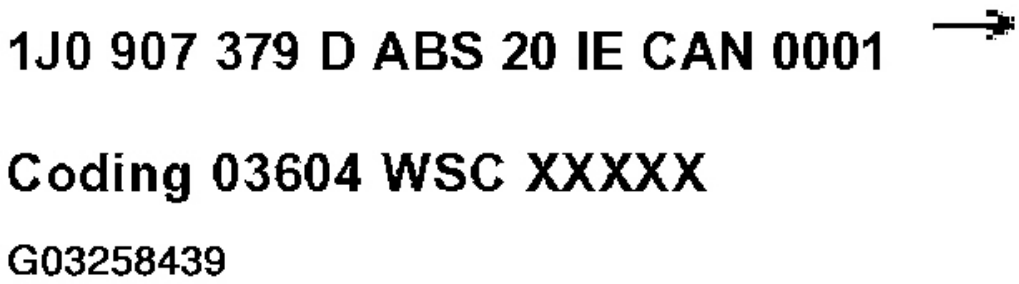


Fig. 127: Identifying Special Tools (1 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- VW 541/1A Lever

- VW 541/5 Press piece
- VW 653/3 Pressure hose

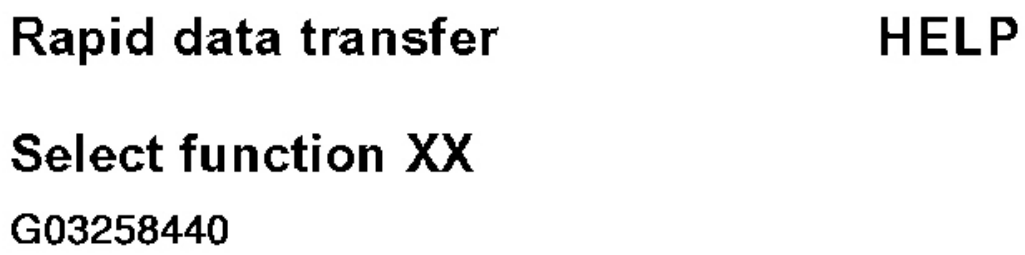


Fig. 128: Identifying Special Tools (2 Of 2)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

- Remove camshaft. See **CAMSHAFT, REMOVING AND INSTALLING** .
- Take out hydraulic lifter and place down with running surface downward. Ensure hydraulic lifters are not interchanged when doing this.
- Disconnect spark plug connectors with tool T10112
- Remove spark plugs with spark plug wrench 3122B.
- Set piston of appropriate cylinder to "bottom dead centre (BDC)".
- Mount assembly device 2036 and adjust mountings to height of studs.

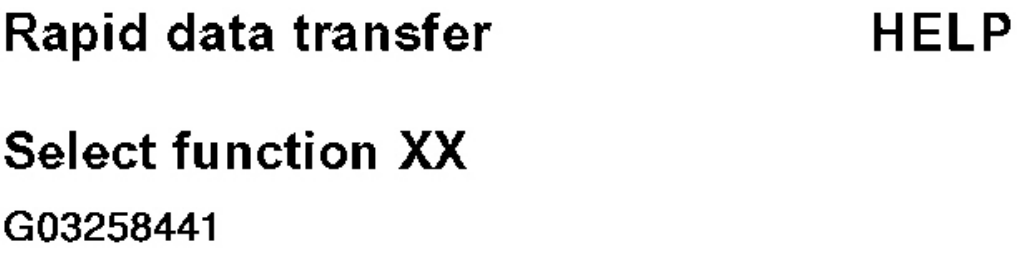


Fig. 129: Mounting Assembly Device 2036, VW 653/3 & VW 541/1A
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Screw pressure hose VW 653/3 into spark plug thread.
- Connect pressure hose to compressed air supply of at least 6 bar.
- Remove valve springs with assembly lever VW 541/1A and thrust piece VW 541/5.

NOTE: Tight keepers can be loosened by tapping lightly on the lever.

- Pull off valve stem seals with 3047A.

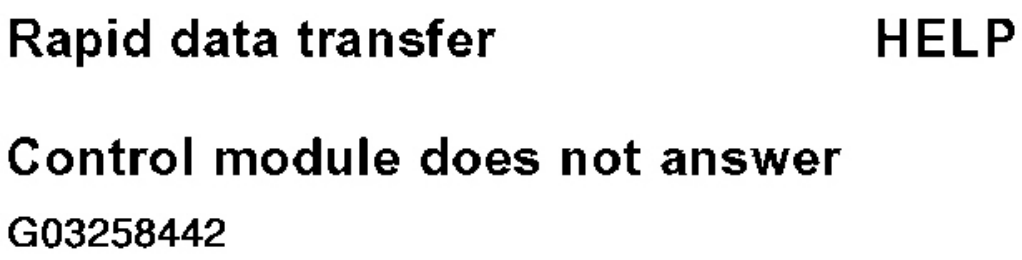


Fig. 130: Removing Valve Stem Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

- Place plastic sleeve -A- supplied on appropriate valve stem. This will prevent new valve stem seal -B- being damaged.

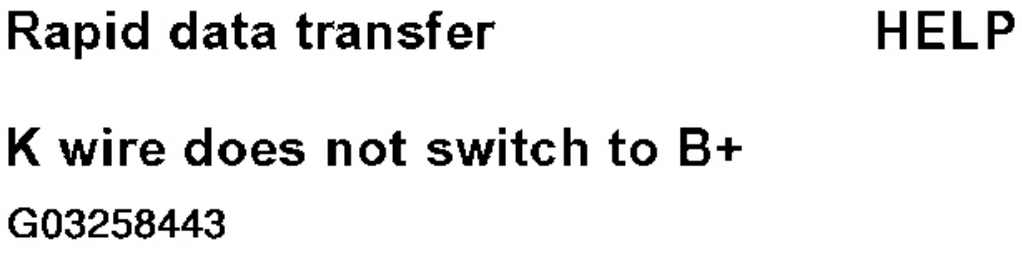


Fig. 131: Installing Valve Stem Seal
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Fit new valve stem seal into installation tool 3129.
- Oil valve stem seal sealing lip and press carefully onto valve guide.

ENGINE - LUBRICATION

LUBRICATION SYSTEM

Lubrication system components, removing and installing

NOTE:

- **Metal shavings or large amounts of small metal particles found in the engine oil during repairs may be caused by a partial seizure of the crankshaft or connecting rod bearings. Perform the following work sequences in this situation to prevent consequential damage once repairs are complete:**
  - **Thoroughly clean oil passages**
  - **Replace oil spray jets**
  - **Replace oil cooler**
  - **Replace oil filter**
- **The oil level must not be above the max. mark or there is a danger of damage to catalytic converter. For markings, see Fig. 136 .**

Disassembling and assembling oil filter bracket. See **Part II (Oil filter housing, disassembling and assembling)** .

Engine codes BDC, BGD

Disassembling and assembling oil pump with balancer shaft gear assembly. See **Oil pump with balancer shaft gear assembly, disassembling and assembling (Engine codes BDC, BGD)** .

Removing and installing oil pump with balancer shaft gear assembly. See **OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING** .

Continuation for all models

Checking oil pressure and oil pressure switch. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING** .

Engine oil specifications

Use engine oils which conform with VW standard 500 00, 501 01 or 502 00. Only in exceptional cases: Multi-grade and single grade oils conforming with API-SF and SG or ACE A A2/A3.

NOTE:

- **In the factory the engine is filled with engine oil conforming with VW standard 503 00. This engine oil is designed for long service intervals**

(ESI).

- **Engine oils conforming to VW standard 500 00, 501 01 or 502 00 may also be used.**

Oil system capacity

See **ENGINE OIL LEVEL, CHECKING** .

Part I (Engine codes AEG, AVH, AZG)

Part II, Disassembling and assembling oil filter housing. See **Part II (Oil filter housing, disassembling and assembling)** .

- For engine codes BDC, BGD, see **Part I (Engine codes BDC, BGD)** .
- For engine code BEV, see **Part I (Engine code BEV)** .

NOTE: The following list refers to items in Fig. 132 .

1. **15 N.m**
2. **Sealing flange**
   - Must be located on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
   - Replacing crankshaft oil seal, poly V-belt pulley end. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING**
3. **Pressure relief valve, 27 N.m**
4. **Oil spray jet**
   - For piston cooling
5. **Dipstick**
   - Oil level must not exceed max. mark!
   - Markings. See **Fig. 135**
6. **Dipstick guide**
   - Fastened to intake manifold
   - Pull off to extract oil
7. **Guide tube**
8. **Dowel sleeves**
9. **O-ring**
   - Replace
10. **15 N.m**

11. **Suction line**
    - Observe part number
    - Clean strainer if soiled
12. **Baffle plate**
13. **15 N.m**
14. **Oil sump protection**
    - Not for all engines. See Parts catalog.
    - Assembly overview. See **Fig. 138**
15. **Oil drain plug, 30 N.m**
    - Replace if leaking. See Parts catalog for correct application. In some cases seal and drain plug are combined; do not interchange with separate seal and drain plug.
16. **Oil sump**
    - Clean sealing surface before installing
    - Insert with silicone sealant D 176 404 A2. See **OIL SUMP, REMOVING AND INSTALLING** .
    - Removing and installing. See **OIL SUMP, REMOVING AND INSTALLING** .
17. **Oil pump**
    - With pressure relief valve of 12 bar
    - Before installing, check that both dowel sleeves for centralizing oil pump/cylinder block are installed
    - Replace if running surfaces and gears are scored
    - Removing and installing. See **Oil pump, removing and installing (Engine codes AEG, AVH, AZG, BEV)** .
18. **Chain sprocket**
    - Observe installing position
19. **20 N.m**
    - Use counter support T10051 to loosen and tighten
20. **Chain**
21. **Chain tensioner with tensioning rail, 15 N.m**
    - When installing, pretension spring and fit

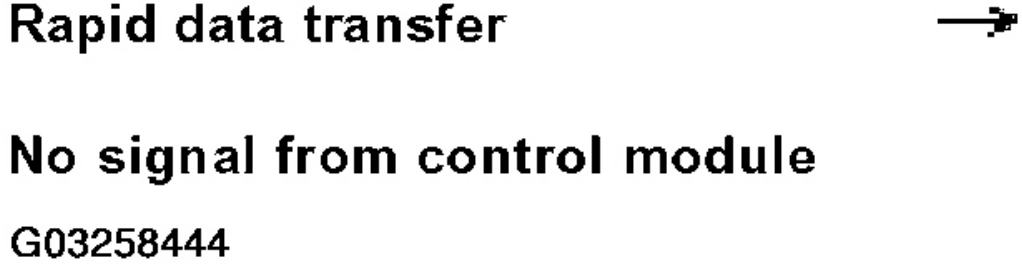


Fig. 132: Exploded View Of Lubrication System Components (Engine Codes AEG, AVH, AZG)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part I (Engine codes BDC, BGD)

- For engine codes AEG, AVH, AZG. See **Part I (Engine codes AEG, AVH, AZG)** .
- For engine code BEV. See **Part I (Engine code BEV)** .

1. **15 N.m**
2. **Sealing flange**
   - Must be seated on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING** .
   - Replacing crankshaft oil seal, ribbed belt pulley end. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING** .

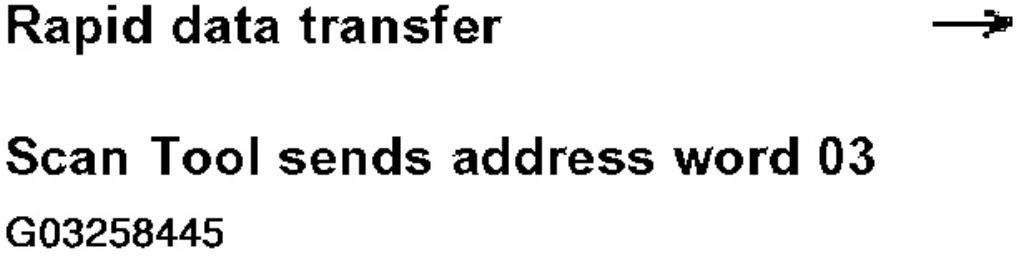


Fig. 133: Exploded View Of Lubrication System Components (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

3. **Cylinder block**
4. **Dipstick**
   - Oil level must not exceed max. mark!
   - Markings. See **Fig. 136**
5. **Dipstick guide**
   - Fastened to intake manifold
   - Pull off to extract oil
6. **Guide tube**
7. **Oil spray jet**
   - For piston cooling
8. **Pressure relief valve, 27 N.m**
9. **Oil pump with balancer shaft gear assembly**
   - With pressure relief valve of 12 bar
   - Removing and installing. See **OIL PUMP WITH BALANCER SHAFT GEAR ASSEMBLY, REMOVING AND INSTALLING** .
   - Disassembling and assembling. See **Oil pump with balancer shaft gear assembly, disassembling and assembling (Engine codes BDC, BGD)** .
10. **15 N.m + 1/4 turn (90°) further**
    - Observe different lengths of bolts. See , **Fig. 137**
11. **15 N.m**
12. **Sump**
    - Clean sealing surface before installing
    - Insert with silicone sealant D 176 404 A2. See **OIL SUMP, REMOVING AND INSTALLING**
    - Removing and installing. See **OIL SUMP, REMOVING AND INSTALLING**
13. **Seal**
    - Replace
    - Cut open seals which have been rolled on
14. **Oil drain plug, 30 N.m**
15. **Chain sprocket**
    - Observe installed position
16. **20 N.m**
17. **Chain guard**
18. **Chain**

Part I (Engine code BEV)

- For engine codes AEG, AVH, AZG. See **Part I (Engine codes AEG, AVH, AZG)**
- For engine codes BDC, BGD. See **Part I (Engine codes BDC, BGD)** .

NOTE: The following list refers to items in Fig. 134 .

1. **15 N.m**
2. **Sealing flange**
   - Must be located on dowel sleeves
   - Insert with silicone sealant D 176 404 A2. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
   - Removing and installing. See **FRONT SEALING FLANGE, REMOVING AND INSTALLING**
   - Replacing crankshaft oil seal, poly V-belt pulley end. See **CRANKSHAFT OIL SEAL - PULLEY END, REPLACING**
3. **Pressure relief valve, 27 N.m**
4. **Oil spray jet**
   - For piston cooling
5. **Dipstick**
   - Oil level must not exceed max. mark!
   - Markings. See **Fig. 135**
6. **Dipstick guide**
   - Fastened to intake manifold
   - Pull off to extract oil
7. **Guide tube**
8. **Dowel sleeves**
9. **O-ring**
   - Replace
10. **15 N.m**
11. **Suction line**
    - Observe part number
    - Clean strainer if soiled
12. **Baffle plate**
13. **Oil sump upper part**
    - Clean sealing surface before installing
    - Insert with silicone sealant D 176 404 A2. See **OIL SUMP, REMOVING AND INSTALLING**
    - Removing and installing. See **OIL SUMP, REMOVING AND INSTALLING**
    - Sell as a set with oil sump lower part protection. For latest oil sump part number:

      See Parts catalog

14. **15 N.m**
15. **22 N.m**
16. **Oil sump lower part protection**
    - Clean sealing surface before installing
    - Insert with silicone sealant D 176 501 A1. See **ENGINE CODE BEV**
17. **Sealing ring**
    - Replace
18. **Oil drain plug, 30 N.m**
    - Replace if leaking. See Parts catalog for correct application. In some cases seal and drain plug are combined; do not interchange with separate seal and drain plug.
19. **10 N.m**
20. **Oil pump**
    - With pressure relief valve of 12 bar
    - Before installing, check that both dowel sleeves for centralizing oil pump/cylinder block are installed
    - Replace if running surfaces and gears are scored
    - Removing and installing. See **Oil pump, removing and installing (Engine codes AEG, AVH, AZG, BEV)**
21. **Chain sprocket**
    - Observe installing position
22. **Chain**
23. **20 N.m**
    - Use counter support T10051 to loosen and tighten
24. **Chain tensioner with tensioning rail, 15 N.m**
    - When installing, pretension spring and fit

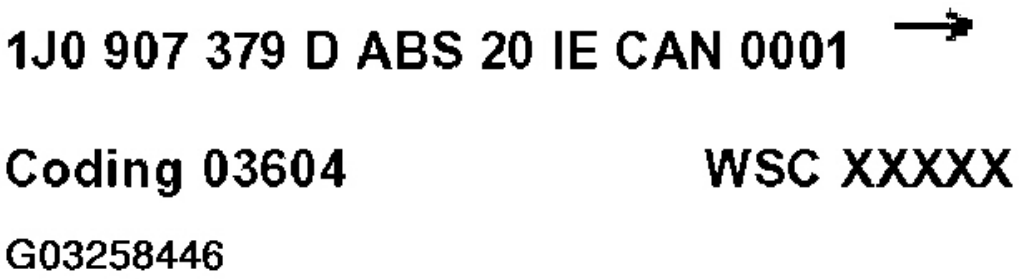


Fig. 134: Exploded View Of Lubrication System Components (Engine Code BEV)

Courtesy of VOLKSWAGEN OF AMERICA, INC.

Dipstick Marks (Engine codes AEG, AVH, AZG, BEV)

NOTE: The following list refers to items in Fig. 135 .

1. max. mark
2. min. mark
    a. Area above hatched field up to max. mark: Do not add engine oil!
    b. Oil level within hatched field: Engine oil may be added
    c. Area from min. mark up to hatched field: Add max. 0.5L. of engine oil!

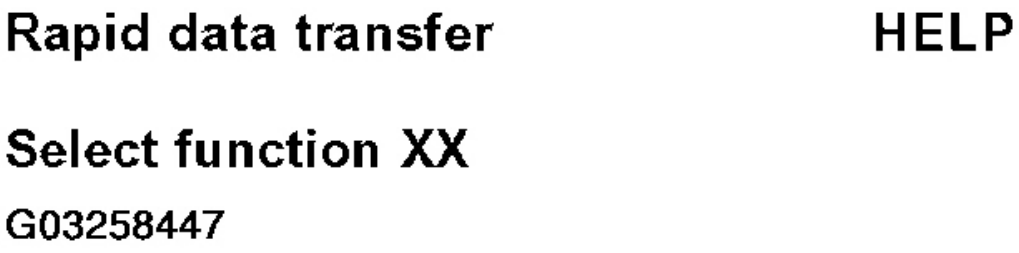


Fig. 135: Identifying Dipstick Marks (Engine Codes AEG, AVH, AZG, BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

(Dipstick Marks) Engine codes BDC, BGD

NOTE: The following list refers to items in Fig. 136 .

1. max. mark
2. Min. mark
    a. Area above hatched field up to max. mark: Do not add engine oil!
    b. Oil level within hatched field: Engine oil may be added
    c. Area from min. mark up to hatched field: Add max. 0.5L. of engine oil!

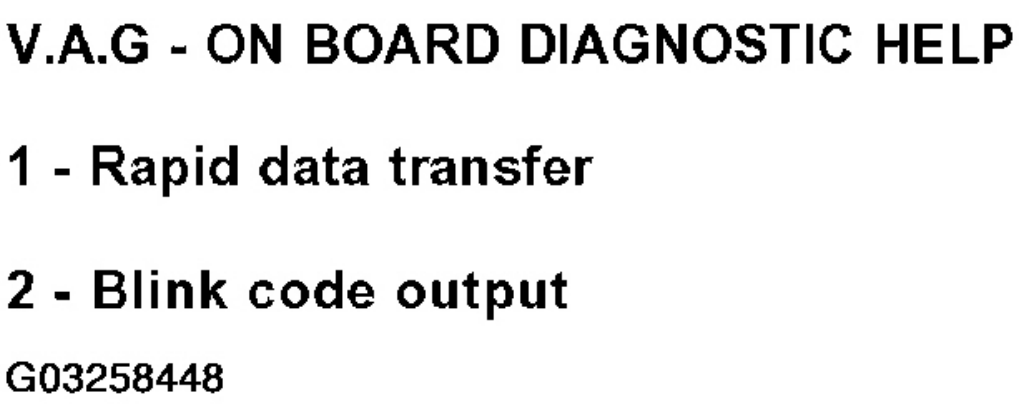


Fig. 136: Identifying Dipstick Marks (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Bolt allocation for balancer shaft gear assembly (Engine codes BDC, BGD)

A. M7 x 40 hex bolt
B. M7 x 55 hex bolt
C. M7 x 90 hex bolt
D. Sealing plug with O-ring

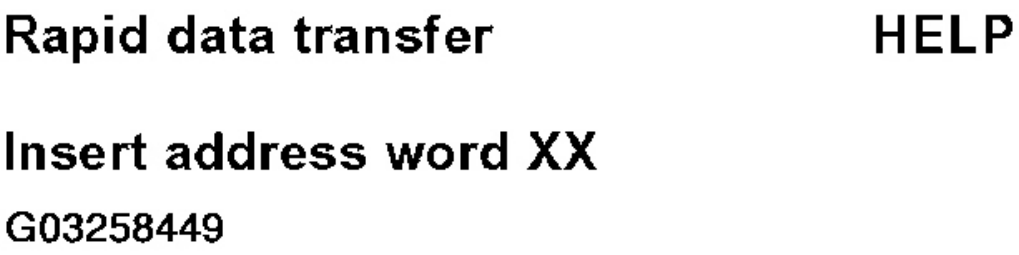


Fig. 137: Identifying Bolt Allocation For Balancer Shaft Gear Assembly (Engine codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: The following list refers to items in Fig. 138 .

1. Rubber grommet
    - located in cylinder block
2. Spreader rivet
3. Spreader rivet
    - to remove oil sump protection push upward
    - to install press in flush
4. Socket
5. Bolt, 37 N.m
    - secure in cylinder block
    - clean threads before installing
    - install with locking compound D 000 600 A2
6. Oil sump protection

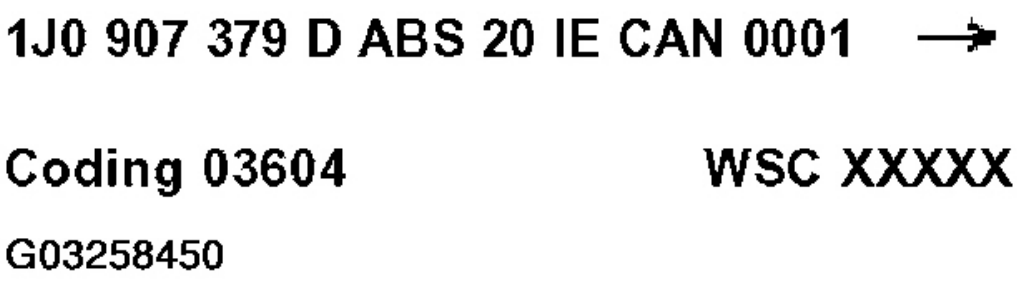


Fig. 138: Exploded View Of Oil Sump Protection Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Part II (Oil filter housing, disassembling and assembling)

NOTE: The following list refers to items in Fig. 139 .

1. **Sealing plug, 40 N.m**
    - Replace
2. **Seal**
    - Installed firmly on item -1-
3. **Spring**
    - For pressure relief valve, approx. 4 bar
4. **Piston**
    - For pressure relief valve, approx. 4 bar

5. **Seal**
    - Replace
6. **Non-return valve, 8 N.m**
    - Various versions: bolted or pressed
    - Press fit valves are not available as spare parts
7. **Seal**
    - Slide on up to shoulder of sealing cover item - 8 -
    - Replace if damaged
8. **Cover**
9. **Retaining clip**
10. **Sealing plug, 15 N.m**
11. **Seal**
    - If sealing ring is leaking cut open and replace.
12. **1.4 bar oil pressure switch -F1-, 25 N.m**
    - Black
    - Checking. See **OIL PRESSURE AND OIL PRESSURE SWITCH, CHECKING**
13. **Seal**
    - If sealing ring is leaking cut open and replace.
14. **Oil filter bracket**
    - With pressed in non-return valve
15. **15 N.m + 1/4 turn (90°) further**
    - Replace
16. **Seal**
    - Replace
    - Clip into lugs on oil cooler
17. **Oil cooler**
    - Coat contact surfaces to oil filter bracket outside seal with AMV 188 100 02
    - Ensure clearance to adjacent components
    - See note. See **LUBRICATION SYSTEM COMPONENTS, REMOVING AND INSTALLING** .
18. **25 N.m**
19. **Oil filter**
    - Loosen with filter strap or oil filter key 3417
    - Tighten by hand
    - Note instructions on filter when installing

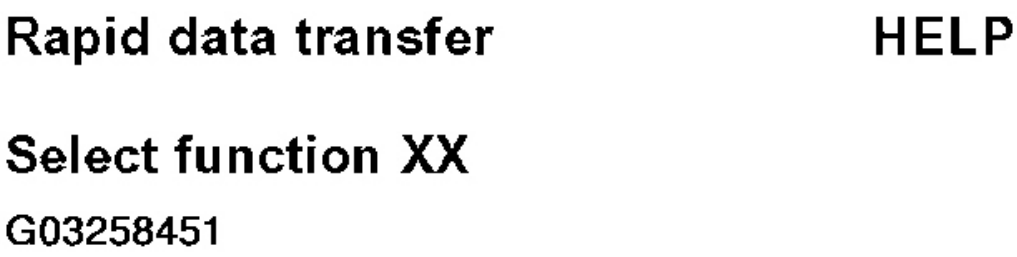


Fig. 139: Exploded View Of Oil Filter Housing
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Oil pump, removing and installing (Engine codes AEG, AVH, AZG, BEV)

Removing

- Remove sump and baffle plate. See **OIL SUMP, REMOVING AND INSTALLING** .
- Unscrew bolt -2-.
- Pull off chain sprocket from oil pump shaft.
- Unscrew bolts -1- and -3- and remove oil pump.

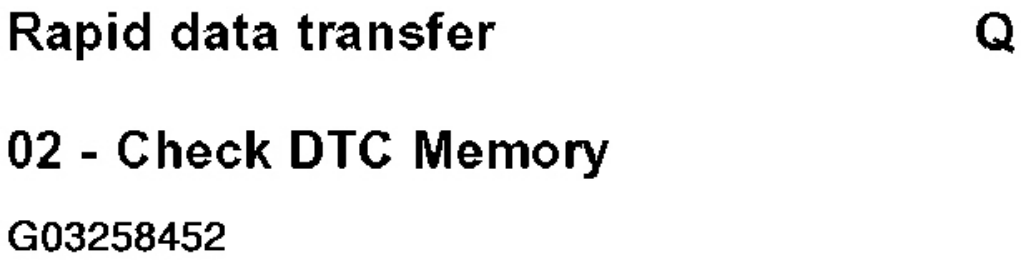


Fig. 140: Removing And Installing Oil Pump (Engine codes AEG, AVH, AZG, BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing

Install in reverse order. Note the following:

Dowel sleeves. See **Fig. 132** , item 8 above oil pump.

- Installed position of oil pump shaft/chain sprocket: Can only be installed in one position.

Installing sump and baffle plate. See **OIL SUMP, REMOVING AND INSTALLING**

Tightening torques. See **Part I (Engine codes AEG, AVH, AZG)**

Oil pump with balancer shaft gear assembly, disassembling and assembling (Engine codes BDC, BGD)

NOTE: The following list refers to items in Fig. 141 .

1. **Chain guard**
2. **Chain**
   - Mark direction of rotation before removing (installation position)
3. **Dowel sleeves**
4. **Oil pump with balancer shaft gear assembly**
   - Before installing, check that both dowel sleeves for centralizing are installed
5. **3 N.m**
   - Insert with locking compound D 000 600 A2
6. **Cover**
   - Prevents engine oil foaming
7. **Oil return union**
   - With seal/gasket
8. **9 N.m**
9. **Suction line**
   - Clean strainer if soiled
10. **8 N.m**
11. **O-ring**
    - Replace
12. **15 N.m + 1/4 turn (90°) further**
    - Observe different lengths of bolts. See **Fig. 137**
13. **O-ring**
    - Replace
14. **Sealing plug, 15 N.m + 1/4 turn (90°) further**
15. **Dowel sleeves**
16. **Outer rotor**
    - Check running surfaces for scoring
    - Marking(s) must be visible

17. **Inner rotor**
    - Check running surfaces for scoring
18. **Oil pump cover**
19. **8 N.m**
20. **Chain sprocket**
21. **20 N.m**
22. **Chain tensioner with tensioning plate**
    - Pre-tension when installing. See **PRE-TENSIONING CHAIN TENSIONER**
23. **15 N.m**

Fig. 141: Exploded View Of Oil Pump With Balancer Shaft Gear Assembly (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Pre-tensioning chain tensioner

- Tension piston by hand (arrow).

Fig. 142: Tensioning Piston (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press chain rail in direction of arrow and lock with a 3 mm Allen key -1-.

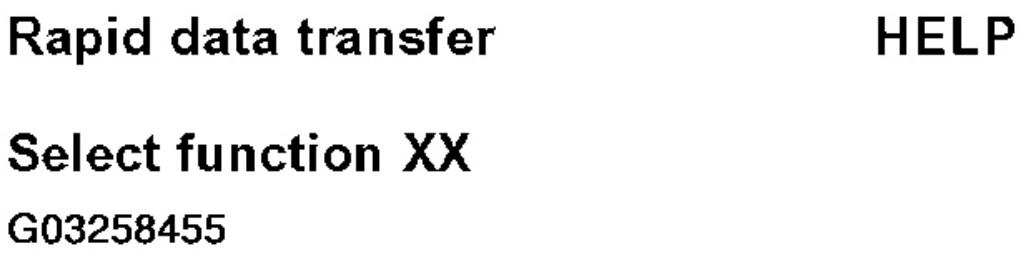


Fig. 143: Pressing Chain Rail (Engine Codes BDC, BGD)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

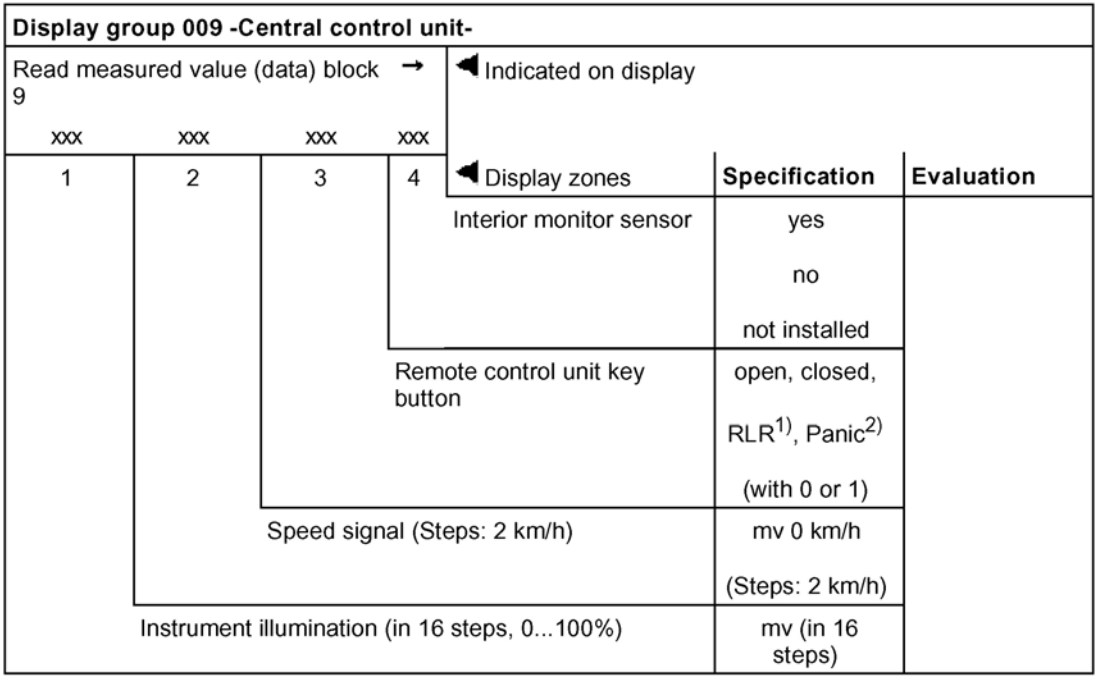
Oil pump with balancer shaft gear assembly, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- T10060 Locking pin

Removing

- Remove oil sump. See **OIL SUMP, REMOVING AND INSTALLING** .



Display group 009 -Central control unit-						
Read measured value (data) block 9 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Interior monitor sensor	yes no not installed	
				Remote control unit key button	open, closed, RLR[1], Panic[2] (with 0 or 1)	
				Speed signal (Steps: 2 km/h)	mv 0 km/h (Steps: 2 km/h)	
				Instrument illumination (in 16 steps, 0...100%)	mv (in 16 steps)	

[1] RLR= Rear Lid Remote Release

[2] Only vehicles for USA, alarm system and turn signal lights are activated

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Fig. 144: Identifying Special Tool T10060
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pull chain guard off. Release locking lugs by inserting a small screwdriver through openings (arrows) if necessary.

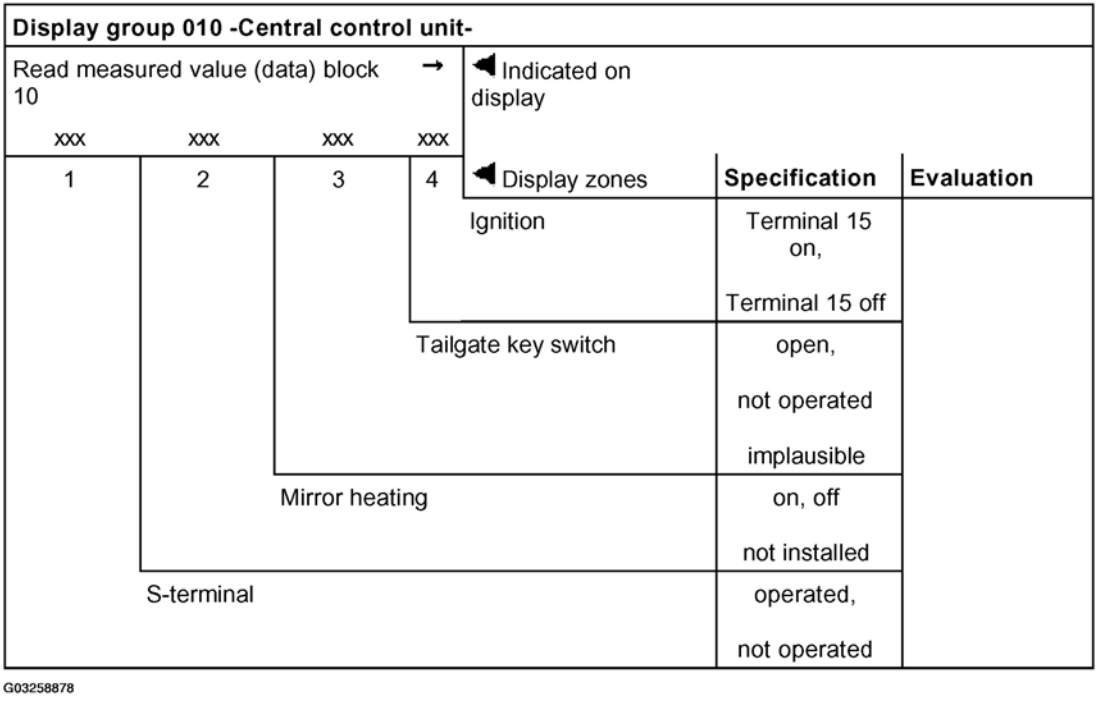

Fig. 145: Removing Chain Guard
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen bolt on oil pump chain sprocket.

Display group 011 -Central control unit-						
Read measured value (data) block 11 →				◄ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◄ Display zones	**Specification**	**Evaluation**
				Empty[1)]		
				Sliding/tilting sunroof released[2)]	yes, no	
				Trunk lid/tailgate contact switch	open, closed	
				Hood contact switch	operated, not operated, not installed	

[1)] Empty means in this case: Display zone is blank

[2)] The central control unit transmits a switch-off delayed terminal 15 to the sliding roof control unit. The sliding/tilting roof can then still be operated from the point when the ignition is switched off until one of the front doors is opened.

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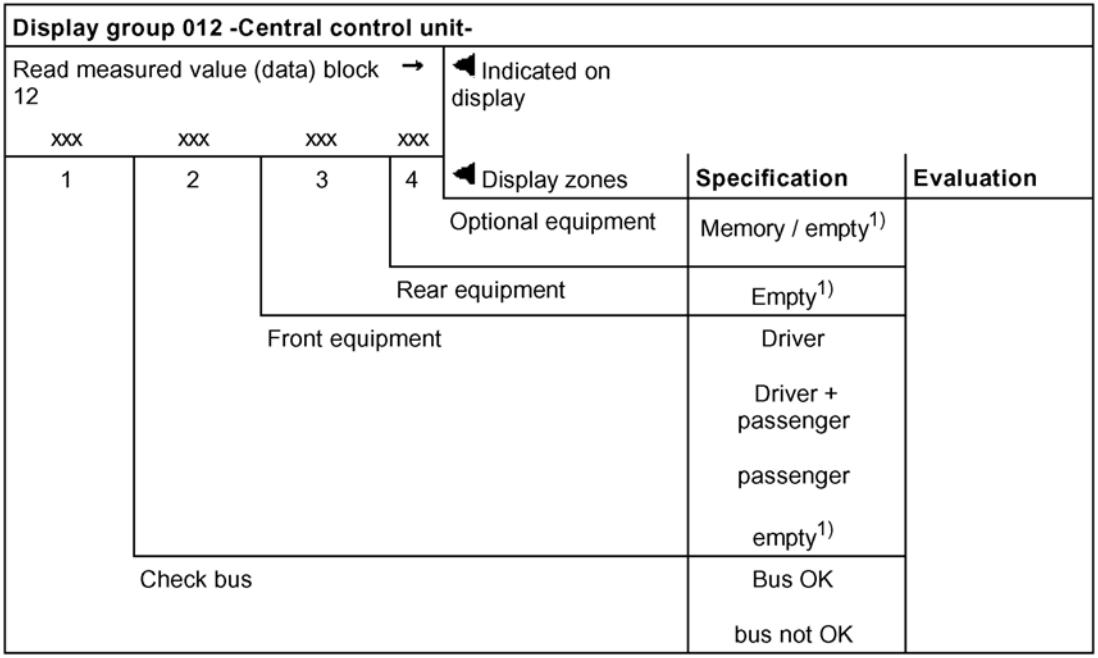
Fig. 146: Loosening Bolt On Oil Pump Chain Sprocket
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Relieve tension on chain rail using a screwdriver (arrow) and lock rail using a 3 mm Allen key -1-.



Display group 012 -Central control unit-						
Read measured value (data) block 12 →				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Optional equipment	Memory / empty[1)]	
				Rear equipment	Empty[1)]	
				Front equipment	Driver	
					Driver + passenger	
					passenger	
					empty[1)]	
		Check bus			Bus OK	
					bus not OK	

[1)] Empty means in this case: Display zone is blank

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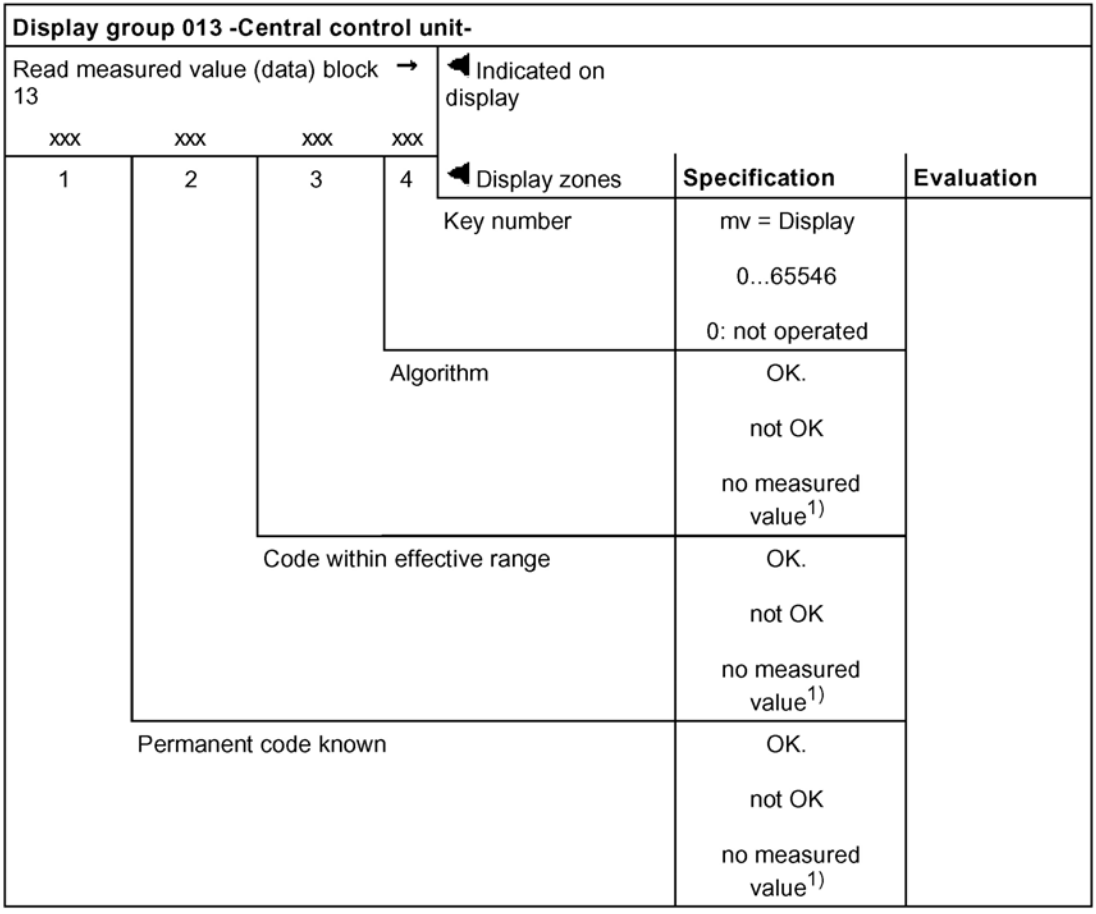
Fig. 147: Relieving Tension On Chain Rail
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Remove oil pump chain sprocket and take chain off balancer shaft gear assembly.



Display group 013 -Central control unit-						
Read measured value (data) block → 13				◀ Indicated on display		
xxx	xxx	xxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Key number	mv = Display 0...65546 0: not operated	
				Algorithm	OK. not OK no measured value[1)]	
				Code within effective range	OK. not OK no measured value[1)]	
				Permanent code known	OK. not OK no measured value[1)]	

[1)] If the remote control key is operated several times the third display - no measured value - will change to "OK".

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Fig. 148: Removing Chain From Balancer Shaft Gear Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen securing bolts on balancer shaft gear assembly (starting at outer sides and working inward) and remove them. Disassembling and assembling oil pump with balancer shaft gear assembly. See **Oil pump with balancer shaft gear assembly, disassembling and assembling (Engine codes BDC, BGD)** .

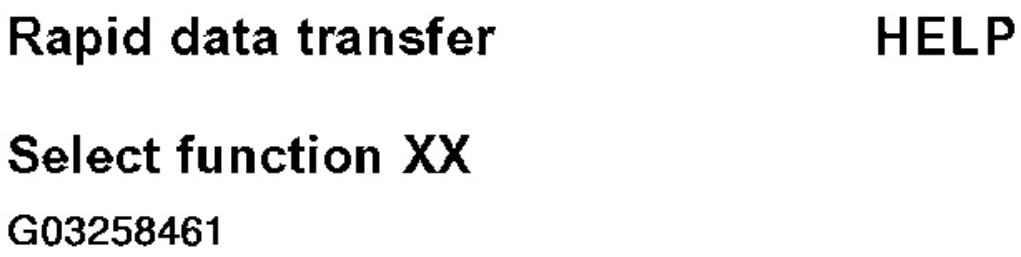

Fig. 149: Loosening Securing Bolts On Oil Pump Balancer Shaft Gear Assembly
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Installing and adjusting oil pump with balancer shaft gear assembly

Requirements

- Chain tensioner pre-tensioned. See **PRE-TENSIONING CHAIN TENSIONER**
- Install oil pump with balancer shaft gear assembly. Tighten securing bolts (starting on inside and working outward) to 15 N.m + 1/4 turn (90°) further.

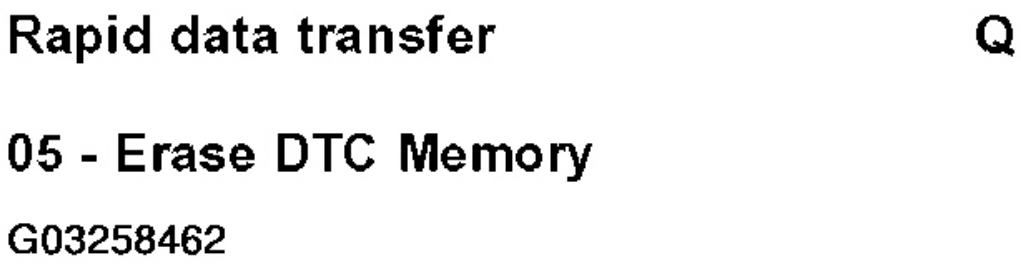

Fig. 150: Locating Oil Pump With Balancer Shaft Gear Assembly Bolts
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Observe different lengths of bolts. See Fig. 137 .

- Set crankshaft to TDC No. 1 cylinder.

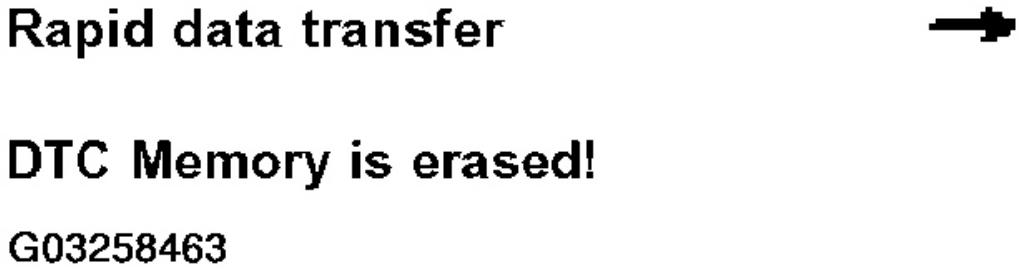

Fig. 151: Locating Marks For Setting Crankshaft To TDC No. 1 Cylinder
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Align mark on balancer shaft chain sprocket (arrow) with fixture hole. Lock chain sprocket in this position with pin T10060. Fit chain onto balancer shaft chain sprocket.

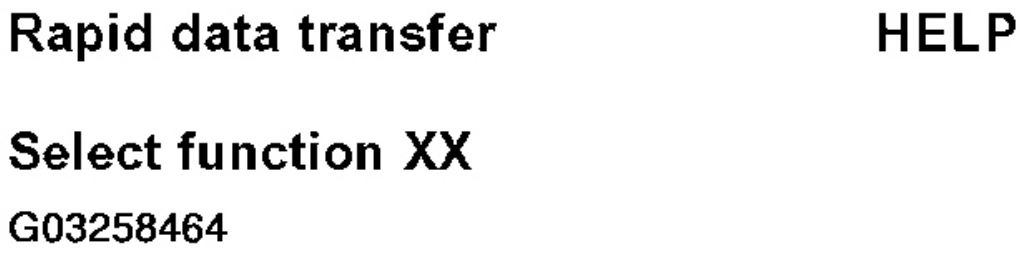

Fig. 152: Aligning Mark On Balancer Shaft Chain Sprocket With Fixture Hole
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Position milled side of oil pump shaft so that it is facing forward.
- Install oil pump chain sprocket and tighten bolt hand tight.

NOTE: The oil pump chain sprocket only fits in one position. Only the oil pump may be turned when installing.

- Remove locking pin T10060 and Allen key -1-. Secure oil pump chain sprocket.

Fig. 153: Removing Locking Pin And Allen Key
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Tightening torque: 20 N.m. Counter support on central bolt of vibration damper.

The rest of the assembly is basically in reverse order to the disassembly sequence.

Oil sump, removing and installing

Special tools, equipment, testers, measuring instruments and auxiliary items required

- 3185 Jointed wrench
- T10058 Socket
- V.A.G1331 Torque wrench (5...50 N.m)
- Hand drill with plastic brush attachment
- Silicone sealing compound D 176 404 A2

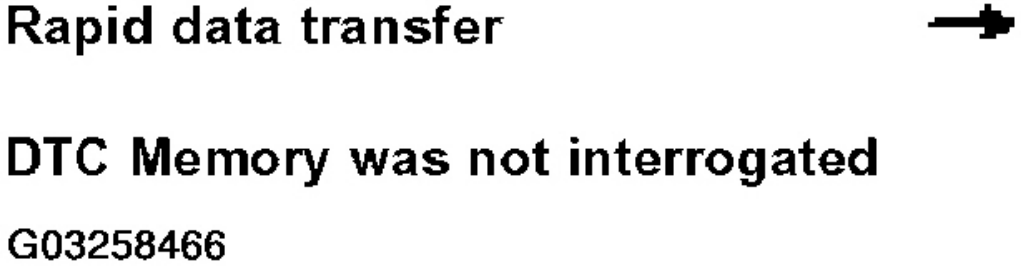

Fig. 154: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Removing

NOTE: For engine code BEV, the oil sump is composed of two parts (upper and lower). The oil sump can be dismounted complete from its union to the engine block. If it is necessary, the upper part may be separated from the lower part. See Part I (Engine code BEV) .

- Remove center and right insulation trays:

  See **NOISE INSULATION, ASSEMBLY OVERVIEW** .

Engines with oil sump protection

1. Rubber grommet
   - located in cylinder block
2. Bolt, 37 N.m
3. Spreader rivet
4. Oil sump protection
   - To remove spreader rivet -3- push upward. See **Fig. 138**
   - Have a second technician push oil sump protection -4- against oil sump.

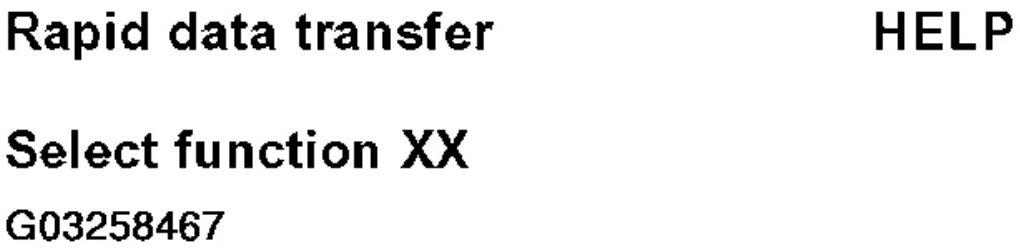

Fig. 155: Removing Oil Sump Protection
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Loosen bolts -2-.
- Carefully remove oil sump protection -4-

Continuation for all models

- Drain engine oil.

NOTE: Observe waste disposal regulations!

- Use jointed wrench 3185 when loosening and tightening sump bolts. Only loosen and tighten bolts on flywheel end using socket T10058
- Remove sump cover and remove sump. It may be necessary to release sump by applying light blows with a rubber headed hammer.
- Remove sealant residue from cylinder block with a flat scraper.
- Remove sealant residue from oil sump with a rotating brush, e.g. a hand drill with a plastic brush attachment (wear eye protection).

Fig. 156: Removing Sealant Residue From Oil Sump With A Rotating Brush
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Clean sealing surfaces. Surfaces must be free of oil and grease.

Installing

NOTE:

- **Note the use-by date of the sealant.**
- **The sump must be installed within 5 minutes of applying silicone sealing compound.**

- Cut off tube nozzle at front marking (nozzle approx. 3 mm diameter).

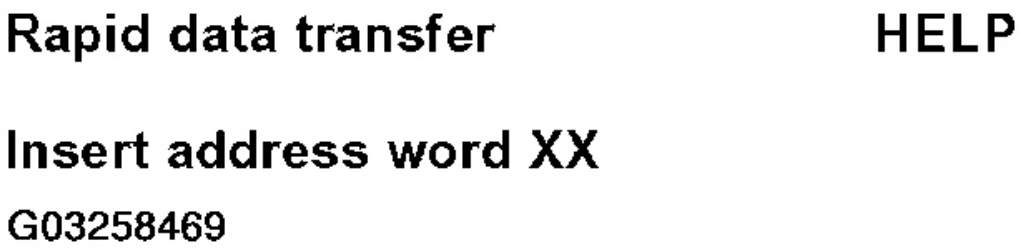

Fig. 157: Applying Silicone Sealing Compound To Sump Sealing Surface
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Apply silicone sealing compound, as shown, to clean sump sealing surface. Sealing compound bead must be:
  - 2...3 mm thick (for engine code BEV: 1...2 mm thick)
  - and run on inside of bolt holes (arrows).

NOTE: **The sealing compound bead must not be thicker, otherwise excess sealing compound will enter the sump and may block the oil suction pipe strainer.**

NOTE:

- **When installing the sump on an engine which is removed from the vehicle, ensure that the sump is flush with the cylinder block on the flywheel end.**
- **The sealant must be allowed to cure for approx. 30 minutes after installing the sump. After this time the engine may be filled with engine oil.**

- Carefully apply sealing compound bead in areas marked by arrows. (illustration shows position of sealant bead on cylinder block).

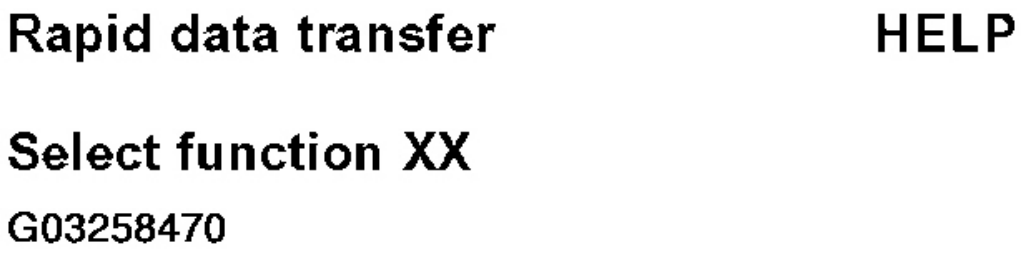

Fig. 158: Locating Areas For Applying Sealing Compound Bead
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Install sump immediately and tighten bolts as follows:

1. Tighten all sump/cylinder block bolts lightly using diagonal sequence.
2. Tighten three sump/transmission bolts lightly.
3. Tighten all sump/cylinder block bolts lightly using diagonal sequence again.
4. Tighten sump/transmission bolts to 45 N.m.
5. Tighten all sump/cylinder block bolts to 15 N.m using diagonal sequence.

Engine code BEV (Oil sump lower part protection)

NOTE:

- **Note the use-by date of the sealant.**
- **The sump must be installed within 5 minutes of applying silicone sealing compound.**

- Apply silicone sealing compound D 176 501 A1, as shown, to clean sump sealing surface.

Rapid data transfer HELP

07 - Code Control Module

G03258471

Fig. 159: Locating Areas For Applying Silicone Sealing Compound (Engine Code BEV)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Sealing compound bead must be A = 1...2 mm. thick.
- and run on inside of bolt holes (arrows).

NOTE:

- **The sealing compound bead must not be thicker, otherwise excess sealing compound will enter the sump and may block the oil suction pipe strainer.**
- **When installing the sump on an engine which is removed from the vehicle, ensure that the sump is flush with cylinder block on the flywheel end.**
- **The sealant must be allowed to cure for approx. 30 minutes after installing the sump. After this time the engine may be filled with engine oil.**

NOTE: Models with oil sump protection

- **Check condition of the rubber grommets located in the cylinder block for spreader rivets, before installing the oil sump protection.**
- **Before tightening bolts, clean the threads and apply D 000 600 A2.**

- Install spreader rivets -3- in oil sump protection -4-. See **Fig. 138**

Code Control Module

Enter code number XXXXX (03604)

G03258472

Fig. 160: Installing Oil Sump Protection
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Tighten bolts -2- to 37 N.m.

Continuation for all models

The rest of the assembly is basically in reverse order to the disassembly sequence.

Oil pressure and oil pressure switch, checking

Special tools, equipment, testers, measuring instruments and auxiliary items required

- V.A.G 1342 Oil pressure tester
- V.A.G 1527 B Diode test lamp
- V.A.G 1594 A Adapter set

1J0 907 379 D ABS 20 IE CAN 0001 →

Coding 03504 WSC XXXXX

G03258473

Fig. 161: Identifying Special Tools
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Function of dynamic oil pressure warning system

The oil pressure switch is open at no pressure and closes when the switch pressure is reached.

The oil pressure is activated approx. 10 seconds after switching the ignition on ("terminal 15 on").

Switch-on delay for oil pressure warning: approx. 3 seconds

Switch-off delay for oil pressure warning: approx. 5 seconds

Checking warning lamp

After switching on the ignition when the engine is not running, the oil pressure warning lamp in the instrument cluster must light up for approx. 3 seconds and go out again. The check is terminated if the engine is running.

Criteria for warning

The optical oil pressure warning switches on (the oil pressure warning lamp flashes) and the buzzer sounds three times for audible warning under one of the following conditions.

- "Ignition on", engine at rest, oil pressure switch closed
- Engine speed higher than 1500 RPM, oil pressure switch open

At an engine speed greater than 5000 RPM the oil pressure warning is not erased; even when the oil pressure switch is closed. Oil pressure warning goes out below 5000 RPM.

If the oil pressure switch is open (engine revs greater than 1500) for 0.5... 3 seconds, this is stored in the processor of the instrument cluster. If this condition happens three times while the engine is running, the oil pressure warning is immediately triggered and remains on, even below 1500 RPM. The oil pressure warning goes out when the oil pressure switch is closed for longer than 5 seconds when engine revolutions are greater than 1500 RPM or the ignition is switched off.

Requirements

- Engine oil level OK, checking. See **Dipstick Marks (Engine codes AEG, AVH, AZG, BEV)**
- Oil pressure warning light -K3- must light up for approx. 3 seconds when ignition is switched on
- Engine oil temperature at least 80 °C (coolant fan must have run once)

NOTE: Functional check and servicing the optical and acoustic oil pressure warning:
See Electrical Wiring Diagrams, Troubleshooting & Component Locations

Work sequence

- Remove Oil pressure switch -F1- and screw into tester.

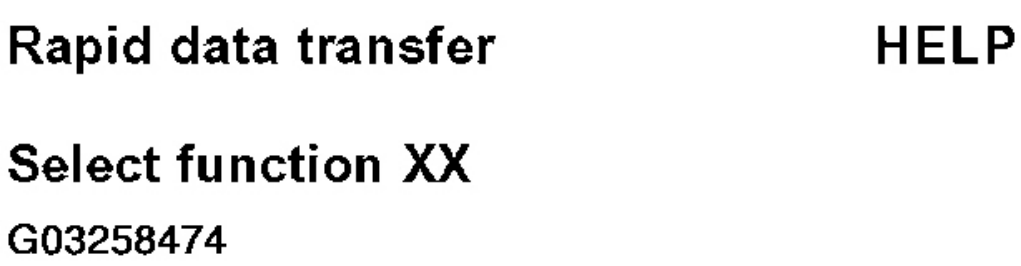

Fig. 162: Checking Oil Pressure And Oil Pressure Switch
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Screw tester into oil filter bracket in place of oil pressure switch.
- Connect brown wire of tester to Ground (-).
- Connect diode test lamp V.A.G 1527 B using auxiliary cables from V.A.G 1594 A to battery positive (+) and oil pressure switch.

  LED must not light up

If the LED lights up:

- Replace 1.4 bar Oil pressure switch -F1-.

If the LED does not light up:

- Start engine and increase revolutions slowly.

  At 1.2...1.6 bar LED must light up

If the LED does not light up:

- Replace oil pressure switch.
- Increase engine speed further.

  At 2000 RPM and an oil temperature of 80 °C oil pressure should be between 2.7... 4.5 bar

  At higher engine speeds the oil pressure must not exceed 7.0 bar

If the specifications are not attained:

- Correct mechanical damage, e.g. bearing damage.
- Check O-ring of sealing plug for damage. See **PRE-TENSIONING CHAIN TENSIONER** , item - 13 -.
- Replace oil filter bracket with pressure relief valve. See **Fig. 139** , item -14 - or (for engine code BDC, BGD) oil pump with balancer shaft gear assembly.

If no failure was found:

- Replace engine pump

If the specification is exceeded:

- Check oil galleries.
- If necessary, replace oil filter bracket with pressure relief valve. See **Fig. 139** , item -14-.